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(71) Applicant:
MATSUSHITA ELECTRONICS CORPORATION
Kadoma-shi, Osaka 571 (JP)

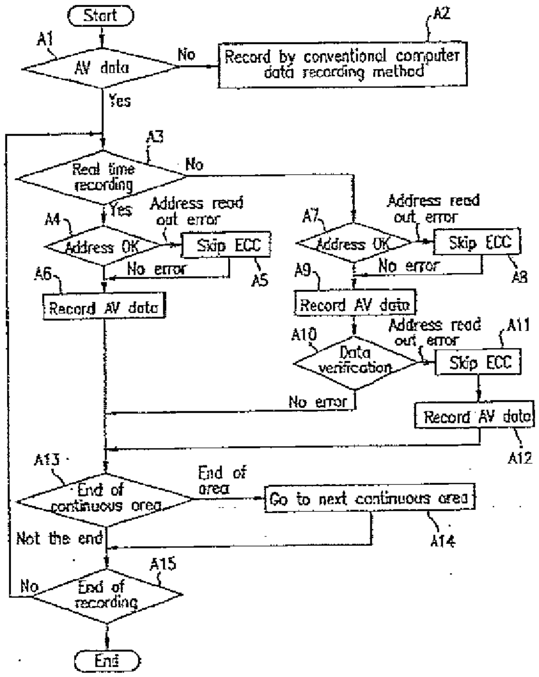
(72) Inventors:
- **GOTOH, Yoshiho**
  Osaka-shi, Oaka 536 (JP)
- **UEDA, Hiroshi**
  Hirakata-shi, Osaka 573 (JP)
- **FUKUSHIMA, Yoshihisa**
  Osaka-shi, Osaka 536 (JP)

(74) Representative:
Marx, Lothar, Dr.
Patentanwälte Schwabe, Sandmair, Marx
Stuntzstrasse 16
81677 München (DE)

(54) RECORDING/REPRODUCING METHOD SUITABLE FOR RECORDING/REPRODUCING AV DATA ON/FROM DISC, RECORDER AND REPRODUCER FOR THE METHOD, INFORMATION RECORDING DISC AND INFORMATION PROCESSING SYSTEM

(57) The present invention relates to a method for recording an AV file using an information recording disk in which data is recorded/reproduced by sectors. The recording method includes the steps of: determining whether or not input data is AV data; detecting a defective sector existing in an assigned data recording area; when the input data is AV data while a defective sector is detected in the data recording area, allocating a defective extent including the defective sector; recording AV data in continuous sectors while skipping the defective extent; and allocating an area of continuous sectors where only the AV data is recorded as one AV extent.

FIG. 1



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Description

TECHNICAL FIELD

The present invention relates to an information recording disk for recording digital data including AV data, a recording method, a reproduction method and a recording apparatus therefor, and an information processing system thereof.

BACKGROUND ART

There are optical disks for recording information such as computer data, e.g., PDs. PD is a rewritable optical disk which employs the phase change system and performs recording and reproduction of data by sectors.

A problem associated with rewritable optical disks is that data recording and reproduction cannot be ensured for every sector due to dust attached to the disk, a scratch on the disk, deterioration of the disk material itself from repeated recording operations, or the like. Such a sector, from which data cannot be normally recorded/reproduced, is called a defective sector. Such a defective sector is typically replacement-recorded based on a linear replacement algorithm.

The linear replacement algorithm is a system where a large number of spare areas are provided in a particular area on the disk so as to replacement-record data to an appropriate sector in the spare area when a defective sector is detected, thereby ensuring the reliability of input data.

In recent years, AV processing environments have been improved in personal computer apparatuses, and it is becoming more common to enjoy audio/video titles with a personal computer apparatus using a CD-ROM, or the like, in which AV data is recorded as being compressed based on a system such as the MPEG system.

However, since the conventional rewritable optical disk and the disk drive apparatus therefor are designed while assuming the use for recording/reproducing computer data, there are various problems when recording/reproducing AV data having different characteristics from those of computer data.

Typically, there is a problem that continuous video reproduction cannot be ensured when reproducing AV data. This is because a defective sector detected during the recording of the AV data is replacement-recorded using a conventional defect management method, whereby the continuous reproduction of AV data is hampered by a delay associated with an access to the spare area during data reproduction.

This problem is particularly conspicuous in the case of the above-described linear replacement algorithm. For example, when a defective sector occurs in the innermost area of the disk while the spare area is provided in the outermost area of the disk, the head moves from the inner area of the disk to the outer area of the disk in accessing the spare area, thereby resulting in a seek time of several hundred milliseconds. Since picture reproduction of video at 30 frames per second is required, if such a seek time as long as several hundred milliseconds is generated, the reproduced images will consequently be interrupted.

A problem in AV data recording is that it is necessary to provide a variety of recording methods. For example, AV data to be transmitted in real time via a broadcast wave, or the like, has to be recorded on the disk in real time. On the other hand, when high quality AV data to be downloaded via the internet, or the like, is asynchronously recorded on the disk, the real time recording is not necessary, but data recording with high reliability is required.

The present invention has been made in view of the above problems and has an objective of providing method and apparatus for recording data which enable real time recording of AV data to a rewritable optical disk and continuous reproduction of the recorded AV data, a reproduction method, a reproduction apparatus and an information recording disk therefor, and an information processing system composed thereof.

DISCLOSURE OF THE INVENTION

A recording method of the present invention is a recording method for recording an AV file including AV data using an information recording disk in which data is recorded/reproduced by sectors, the recording method including the steps of: determining whether or not input data is AV data; detecting a defective sector existing in a data recording area assigned for recording the input data; when it is determined that the input data is the AV data and a defective sector is detected in the data recording area, allocating a defective extent including the defective sector; recording the AV data in continuous sectors while skipping the defective extent; and allocating an area of continuous sectors where only the AV data is recorded as one AV extent, wherein an AV file is recorded on the information recording disk, wherein the AV file includes: a defective extent, which includes, when a defective sector is included in the data recording area, the defective sector; and one or more AV extents each including a plurality of continuous sectors, thereby realizing the above-described objective.

Only a sector where an address error is detected during a data recording operation may be detected as the defective sector.

The defective sector may include a sector where an address error is detected during a data recording operation and a sector where a data error is detected during a data verification operation.

When using an information recording disk where an ECC block has a plurality of sectors, the defective extents may be allocated by ECC blocks.

When using an information recording disk where an ECC block has a plurality of sectors, the method may further include the step of allocating, in the AV file, a padding extent which does not include AV data.

The method may further include the step of recording attribute information for identifying the AV file including AV data, as part of file management information.

The method may further include the step of recording attribute information for identifying the defective extent and the AV extent, as part of file management information, in such a format that the attribute information is in one-to-one correspondence with the respective extents forming an AV file.

A recording apparatus of the present invention is a recording apparatus for recording AV data on an information recording disk in which data is recorded/reproduced by sectors, the recording apparatus including: a section for determining whether or not input data is AV data; a section for detecting a defective sector existing in a data recording area assigned for recording the input data; and a section for recording the AV data in continuous sectors while skipping the defective sector, wherein AV data is recorded in a plurality of continuous sectors on the information recording disk while skipping a defective sector existing in the data recording area, thereby realizing the above-described objective.

Only a sector where an address error is detected during a data recording operation may be detected as the defective sector.

The defective sector may include a sector where an address error is detected during a data recording operation and a sector where a data error is detected during a data verification operation.

When using an information recording disk where an ECC block has a plurality of sectors, the defective sectors may be skipped by ECC blocks each including the defective sector.

An information processing system of the present invention is an information processing system including: the above-described recording apparatus; and a control device for controlling the recording apparatus, the information processing system including: a section for allocating, in recording of an AV file, a defective sector detected by the recording apparatus as a defective extent; and a section for allocating continuous sectors where only AV data is recorded by the recording apparatus as an AV extent, wherein an AV file is recorded on the information recording disk, the AV file including: a defective extent, which includes, when a defective sector is included in the data recording area, the defective sector; and one or more AV extents each including a plurality of continuous sectors, thereby realizing the above-described objective.

When using an information recording disk where an ECC block has a plurality of sectors, the control device may allocate the defective extent by ECC blocks each including a defective sector.

When using an information recording disk where an ECC block has a plurality of sectors, the control device may further include a section for allocating a padding extent which does not include AV data, as part of the AV file.

The control device may further include a section for recording attribute information for identifying the AV file including AV data, as part of file management information.

The control device may further include a section for recording attribute information for identifying the defective extent and the AV extent, as part of file management information, in such a format that the attribute information is in one-to-one correspondence with the respective extents forming an AV file.

The control device may include a section for setting in the recording apparatus an acceptable value for the total number of sectors skipped when a defective sector is detected during a recording operation for AV data; and the recording apparatus may include a section for, after AV data has been recorded while skipping defective sectors within a range not exceeding the acceptable value, informing the control device of location information of all the sectors skipped during a recording operation for AV data.

The recording apparatus may include a section for, each time a defective sector is detected during a recording operation for AV data, informing the control section of the detection of the defective sector along with location information of the defective sector; and the control section may include a section for setting in the recording apparatus a new recording start location for AV data each time the detection of the defective sector is informed.

A reproduction method of the present invention is a reproduction method for performing data reproduction from the information recording disk on which the AV file is recorded using the above-described recording method, the method including the step of, in an AV data reproduction operation from the AV extent, performing a continuous data reproduction operation while neglecting location information of a replacement-recorded defective sector and not performing a recovery process even when an error occurs during data reproduction, thereby realizing the above-described objective.

A reproduction apparatus of the present invention is a reproduction apparatus for performing data reproduction from the information recording disk on which the AV file is recorded using the above-described recording method, the apparatus including a section for, in an AV data reproduction operation from the AV extent, performing a continuous data reproduction operation while neglecting location information of a replacement-recorded defective sector and not performing a recovery process even when an error occurs during data reproduction, thereby realizing the above-described objective.

An information recording disk of the present invention is an information recording disk in which an AV file including AV data is recorded/reproduced by sectors, wherein the AV file includes: a defective extent, which includes, when a defective sector is included in the data recording area assigned for file recording, the defective sector; and one or more AV extents recorded in a plurality of continuous sectors where only the AV data is recorded, thereby realizing the above-described objective.

Only a sector where an address error may be detected during a data recording operation is regarded as the defective sector.

The defective sector may include a sector where an address error is detected during a data recording operation and a sector where a data error is detected during a data verification operation.

When using an information recording disk where an ECC block has a plurality of sectors, the defective extents may be allocated by ECC blocks.

When using an information recording disk where an ECC block has a plurality of sectors, the AV file may include a padding extent which does not include AV data.

Attribute information for identifying the AV file including AV data may be further recorded as part of file management information.

Attribute information for identifying the defective extent and the AV extent may be further recorded, as part of file management information, in such a format that the attribute information is in one-to-one correspondence with the respective extents forming an AV file.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a flow chart illustrating a recording operation for AV data according to the present invention.

Figure 2 is a flow chart illustrating a recording operation for an AV file including creation of file management information.

Figure 3 is a diagram illustrating a data structure of a file and file management information.

Figures 4A to 4D are each a diagram illustrating a physical structure of an optical disk such as a DVD-RAM.

Figure 5 is a diagram illustrating a structure of a volume space.

Figure 6 is a diagram illustrating a physical sector structure.

Figure 7 is a diagram illustrating a structure of an ECC block.

Figure 8 is a diagram illustrating a directory structure.

Figure 9 is a diagram illustrating how an AV file is recorded.

Figure 10 is a diagram illustrating a data structure of an allocation descriptor.

Figures 11A and 11B are each a diagram illustrating interpretation of the upper two bits of an extent length included in the allocation descriptor.

Figure 12 is a diagram illustrating a recording state of a disk on which an AV file and a computer file are mixedly recorded.

Figure 13 illustrates a data structure for free area management in AV file recording.

Figure 14 is a flow chart illustrating a method for reproducing an AV file.

Figure 15 is a block diagram illustrating a structure of an information processing system of the present invention.

Figure 16 is a diagram illustrating a protocol used between a control section and a disk recording drive when recording in real time AV data received via a broadcast wave.

Figure 17 is a diagram illustrating a protocol used between a control section and a disk reproduction drive in a reproduction operation for AV data recorded on an information recording disk.

Figure 18 is a block diagram illustrating another structure of the information processing system of the present invention.

Figure 19 is a diagram illustrating a protocol used between a control section and a disk recording drive when asynchronously recording AV data received via the internet on an information recording disk.

Figures 20A and 20B are diagrams illustrating processes performed by a control section and a microprocessor, respectively, in real time recording of AV data.

Figure 21 is a diagram illustrating processes performed by a control section in asynchronous recording of AV data.

Figure 22 is a diagram illustrating an example of a file/directory structure.

Figure 23 is a diagram illustrating a data structure and logical relationship of the primary file management information defined by the ISO 13346 standard.

Figure 24 is a diagram illustrating a data structure for defect management used for recording a computer file.

Figure 25 is a diagram illustrating a data structure of the ICB tag.

Figure 26 is a diagram illustrating a data structure of flag fields included in an ICB tag.

BEST MODE FOR CARRYING OUT THE INVENTION

(Embodiment 1)

Hereinafter, a rewritable optical disk, and a data recording method and a data reproduction method therefor will be described as an example of the present invention.

(1) OPTICAL DISK

(1-1) PHYSICAL STRUCTURE

Referring to Figures 4A to 4D, 5, 6 and 7, the physical structure of a DVD-RAM disk, which is a rewritable optical disk, will be described.

Figures 4A to 4D are diagrams each illustrating the physical structure of a DVD-RAM disk. As illustrated in Figure 4A, the DVD-RAM disk includes, from the inner area thereof, a lead-in area, a data area and a lead-out area. Digital data is recorded in each area and is managed in units called sectors.

Figure 6 illustrates a structure of a sector. Data to be recorded in each sector is optically recorded as a recording mark on the land and groove portions based on a phase change recording system, and the physical address corresponding to each sector is physically recorded as pits in the header region. Two Kbytes of data are stored in the sector. Moreover, as illustrated in Figure 7, an ECC (Error Correcting Code) operation is performed for each group of 16 sectors by providing a parity code thereto for the purpose of error correction. Hereinafter, such a group will be referred to as an ECC block.

Herein, it should be noted that the rewritable information capacity is doubled in the DVD-RAM by allowing data to be written on the groove portion, as well as on the land portion, thus being a disk medium better suited for recording video information.

As illustrated in Figure 4B, a data area is further divided into 24 zones numbered from 0 to 23, and data is recorded in each zone by physical sectors each of 2048 bytes. Moreover, as illustrated in Figure 4B, a defect management area (DMA) is provided in the lead-in area and in the lead-out area, and the replacement location information of an ECC block, which has been replaced based on the linear replacement algorithm, will be recorded therein.

As illustrated in Figure 4C, each zone in the data area is composed of a user area for recording user data and a replacement region for replacing a defective sector. Logical sector numbers (LSNs) are assigned to the physical sectors in the user areas, starting from the inner area. Thus, a volume area for recording user data is formed, as illustrated in Figure 4D.

Figure 5 illustrates the structure of a volume space including the user areas of the respective zones, wherein volume structures for handling the disk as a logical volume are provided respectively in the inner area and in the outer area, while a partition space is allocated therebetween, in which files are recorded by a user. In the partition space, logical block numbers (LBNs) are assigned to the respective sectors, starting from the leading sector thereof.

(1-2) FILE SYSTEM STRUCTURE

Next, referring to Figures 3, 8, 10, 11A and 11B, a file system structure of the DVD-RAM will be described. The file system is a data structure for managing data recorded by sectors as files and directories. The file system of the present embodiment is in conformity with the file system defined by the ISO/IEC 13346 standard.

Figure 8 illustrates a directory structure after an AV file is recorded. Directory **A** is under the root directory, while file **B** and an AV file are under directory **A**.

C2 in Figure 3 illustrates a data structure of the partition space, in which the files illustrated in Figure 8 are recorded.

Space bit map descriptors are recorded in LBNs 0 to 79. The space bit map descriptors each have a space bit map indicating whether each sector is allocatable or not. When the operation ip(x) represents the integral portion of x, while the operation rem(a,b) represents a-bxip(a/b), the sector allocation information of a sector at LBN s is registered at bit rem(s,8) in byte ip(s/8) in the space bit map. When the bit value is 1, the sector is unallocated, while 0 means allocated. In the example of C4, the bits corresponding to the unallocated sectors at LBNs 84 to 583, 586 to 3584 and 3888 to the end are set to 1.

A file set descriptor is recorded at LBN 80. In the case of a file entry of the root directory, the location information is recorded in the file set descriptor.

A terminating descriptor is recorded at LBN 81. The terminating descriptor indicates the end of the file set descriptor.

A file entry is recorded at LBN 82.

Since the ISO 13346 standard accommodates a rewritable disk, as well as a read only disk, the recording location of the file is stored and managed in information called a file entry.

In a file entry, various attribute information particular to the file and the recording location of the file are recorded. In a directory, the file names of the files included in the directory and the location information of the file entries are recorded.

A file entry indicates the recording address of a file existing in the partition space by an allocation descriptor field. C6 illustrates the structure of the file entry.

A descriptor tag is provided for identifying a descriptor such as a space bit map descriptor. In the case of a file entry, 261 is described as the descriptor tag, indicating a file entry.

An ICB tag is for indicating the attribute information relating to the file entry itself.

Figure 25 is a diagram illustrating the structure of an ICB tag, while Figure 26 is a diagram illustrating the structure of flag fields of the ICB tag. In Figure 25, there is a flag field of 2 bytes at RBP 18 in the ICB tag. In Figure 26, a flag indicating whether the file is an AV file or not is assigned to the ninth bit in the flag field. When an AV file is identified from this flag, AV data is recorded in the group of sectors forming the file.

Extended attributes are for describing attribute information of a more advanced level than the level defined by the attribute information field in the file entry.

The allocation descriptor is for managing an area including continuous sectors as one extent. As illustrated in Figure 10, the allocation descriptor has the extent length and the location information thereof. Figure **11A** illustrates the interpretation of the upper two bits of the extent length included in the allocation descriptor of a non-AV file. It is thus possible to indicate whether the extent has been allocated or not and whether it has been recorded or not. Figure **11B** illustrates the interpretation of the upper two bits of the extent length included in the allocation descriptor of an AV file. It is thus possible to indicate whether the extent is an AV extent, a defective extent or a padding extent.

Hereinafter, as supplementary description, an operation of the disk reproduction drive apparatus for acquiring a sector address storing a desired file will be described.

Figure **22** illustrates an example of a file/directory structure. An ellipse represents a directory while a rectangle represents a file. In this example, a directory, DVD_VIDEO, and two files, File1.DAT and File2.DAT, exist under the Root directory. The directory DVD_VIDEO further includes a total of three files, Movie1.VOB, Movie2.VOB and Movie3.VOB.

Figure **23** illustrates logical relationship of data in the file management information based on the ISO 13346 standard.

Since the ISO 13346 standard accommodates a rewritable disk, as well as a read only disk, the recording location of the file is stored and managed in information called a file entry.

For example, the recording location of the file entry for the AV file Movie1.VOB is stored as a file identifier descriptor in the DVD_VIDEO directory file. The recording location of the file entry for the DVD_VIDEO directory file is stored as a file identifier descriptor in the ROOT directory file. Moreover, the recording location of the file entry for the ROOT directory file is stored in a file set descriptor. Furthermore, the file set descriptor is recorded in a predetermined location as a part of the file management information. With such a structure, the recording location of the target file can be acquired by first referring to the file set descriptor and then following the file entries starting from the ROOT directory according to the directory hierarchical structure. A directory file has a plurality of file identifier descriptors, and each file identifier descriptor includes the recording address and the file name of the file entry of the file or directory managed by the directory.

(1-3) DEFECTIVE SECTOR MANAGEMENT METHOD 1: FOR COMPUTER DATA

When recording computer data on the above-described DVD-RAM, the linear replacement algorithm is employed as a defect management method. In the linear replacement algorithm, the computer data is first recorded in the user area. When a defective sector is detected during the recording operation by detecting an address error, a verify error, or the like, an ECC block including the defective sector is recorded in a spare area illustrated in Figure **4C**, while the location information of the replaced ECC block is recorded as defect management information in the defect management area (DMA) provided in the lead-in area and in the lead-out area.

Figure **24** illustrates the data structure of the defect management area. As illustrated in Figure **24**, the defect management area includes a disk definition sector and a defect list. The disk definition sector stores the location information of the defect list. The defect list includes a defect entry having pairs of leading addresses (address **A** and address **C**) of ECC blocks, which each include a defective sector, and leading addresses (address **B** and address **D**) of other ECC blocks respectively replacing the ECC blocks. Such a defective sector is detected when formatting the disk, when recording data to the disk, or the like. The example illustrated in Figure **24** shows that the ECC block starting from address **A** in the data area is replaced by the ECC block starting from address **B**, while the ECC block starting from address **C** is replaced by the ECC block starting from address **D**. Thus, in the linear replacement algorithm, defective sectors are managed in an integrated manner by the defect management information recorded in the defect management area.

(1-4) DEFECTIVE SECTOR MANAGEMENT METHOD 2: FOR AV DATA

Hereinafter, the outline of the defect management method will be described, which is a feature of the present invention and used when recording AV data on the above-described DVD-RAM. Herein, AV data refers to, for example, data including a sound or a video compressed by MPEG. For example, when a defective sector, for which address cannot be reproduced, is detected during an AV data recording operation, the ECC block including the defective sector is skipped, and the data is recorded from the beginning of the following ECC block. The recording location of the ECC block including the defective sector is registered in the file entry as one allocation descriptor. Moreover, when a large number of defective sectors are detected in the AV file recording operation, the location information of the defective sectors is registered in the file entry for the AV file using separate allocation descriptors. Thus, such a defect management method is different from the conventional linear replacement method in that the location information of the replaced ECC block is never recorded in the defect management area provided in the lead-in area or in the lead-out area.

Moreover, in an AV file reproduction operation, since the AV data is reproduced while skipping defective sectors with reference to the allocation descriptors in the file entry, the disk reproduction drive is able to reproduce AV data while skipping the defective sectors without managing the addresses of the defective sectors.

(2) DATA RECORDING METHOD

Hereinafter, a method for recording AV data to the above-described DVD-RAM will be described. Figure 1 is a flow chart illustrating a recording operation for AV data according to the present invention.

First, it is determined whether the input data is AV data or not (step **A1**). This determination is based on the type of command sent from the host, the mode in which data is transferred from the host, or the like. For example, when Write_AV command is sent for recording AV data, it is determined to be AV data, while it is determined to be normal computer data when normal Write command is sent.

When recording file management information and computer data including code data, they are recorded based on the conventional linear replacement algorithm while verifying the defective sectors (step **A2**).

In the case of AV data, it is further determined (step **A3**) whether the data is the AV data which requires real time recording, such as those sent from a digital video movie, digital broadcasting, or the like, or the AV data which can be asynchronously recorded while preferentially ensuring the reliability thereof, such as data downloaded from the internet. For example, when the synchronous mode is set as the data transfer mode from the host computer to the recording apparatus, it is determined to be real time recording, while it is determined to be non-real time recording when the asynchronous mode is set. Alternatively, it can be determined to be real time recording when the data is transferred from a digital video movie, or the like, based on the type of equipment connected to the recording apparatus, while it can be determined to be non-real time recording when the data is transferred from network equipment such as those used for the internet.

In the recording operation for AV data which requires real time recording, when an address error is detected from the target sector, the ECC block including the sector is skipped, and the data is recorded from the leading sector in the following ECC block (steps **A4** to **A6**). By recording data while skipping ECC blocks including defective sectors as described above, it is possible to continue the data recording operation without performing any seek operation even if a defective sector is detected, unlike the replacement recording for computer data as illustrated in Figure **4C**.

In the recording operation for AV data for which the asynchronous recording is applied while preferentially ensuring the reliability thereof, when a defective sector having an address error is detected during the data recording, the ECC block including the defective sector is skipped, and the data is recorded from the leading sector in the following ECC block (steps **A7** to **A9**), as described above. Then, the recorded data is read out and verified. If a defective sector including a data error is detected, the recorded data is recorded in the following ECC block (steps **A10** to **A12**). By performing such a data recording operation, a defective sector is reliably detected, while it can be recorded in the following ECC block, rather than in a spare area, whereby a video or a sound can be reproduced uninterruptedly. When completing the data recording for a continuous area which is previously specified by a command, or the like, data recording is resumed for the next continuous area (steps **A13** to **A14**).

For simply illustrating the data recording operation for the DVD-RAM disk in which an ECC block is composed of a plurality of sectors, it is assumed in the above description that the entire ECC block including a defective sector is skipped. However, it is apparent that it is possible to similarly perform a data recording method in which only the defective sector, rather than the entire ECC block, is skipped. Moreover, the defective sector is skipped by sectors also in the case where the ECC block has the same size as the sector size.

C3 in Figure **3** illustrates the data structure of the disk, on which an AV file is recorded by the above-described recording method. Hereinafter, the data structure will be described referring to Figure **9**, which describes **C2** and **C3** of Figure **3** in detail. A first continuous area at LBNs 592 to 3567 and a second continuous area at LBN 3888 to the end, both unallocated, are previously specified as recording areas for the AV file so that the recording is made from the beginning of the ECC block. When recording AV data which requires real time recording, the AV data recording is first performed from the leading sector in the first continuous area. Then, an address error is detected from the sector at LBN 1600, whereby the ECC block (16 sectors) including this defective sector is skipped, and the AV data is recorded in the following ECC block is performed, starting at LBN 1616. Following the completion of the data recording operation for the first continuous area, a data recording operation for the second continuous area, which starts at LBN 3888, is performed. When recording AV data for which the asynchronous recording is applied while preferentially ensuring the reliability thereof, if a data error is detected from the sector at LBN 1600, the ECC block including the defective sector is skipped and the AV data is recorded in the following ECC block, as described above. Thus, the real time recording and the asynchronous recording both employ the same data structure since AV data is recorded while skipping an ECC block including a defective sector in both cases. Therefore, when reproducing AV data, defective extent S is skipped while only AV extents **A**, **B** and **C** are read out in the same manner. Even when unallocated areas exist discretely on the disk, uninterrupted reproduction of a video or a sound is ensured during the AV data reproduction, as long as an amount of data more than a predetermined amount can be recorded in each of the unallocated areas while the distance between the unallocated areas is in a range which allows for the areas to be accessed within a predetermined amount of time. This is because the AV data read out from the disk by the disk reproduction apparatus is reproduced after it is temporarily stored in a track buffer, or the like. In other words, since AV data stored in the buffer is reproduced during an access operation between continuous areas, the continuous reproduction of a video or a sound is maintained even if data reproduction from the disk is temporarily discontinued.

Next, referring to Figure **2**, a method for creating and registering file management information for AV file according to the present invention will be described.

First, it is determined whether the file to be recorded is an AV file or not. This determination is based on, for example, the file name extension or the file's attribute provided by an application program, a user, or the like (step **B1**). In the case of file management information such as a directory file or a data file for computers, a file recording operation and a file management information registration are performed based on the conventional file system of ISO 13346 (step **B2**). When the file to be recorded is an AV file, a continuous free area of 5 MB or larger is searched for by ECC blocks based on the contents of the space bit map (step **B3**). For example, in **C4** of Figure **3**, the continuous area at LBNs 592 to 3567 and the continuous area at LBN 3888 to the end are searched for as the continuous free area. Then, based on the recording method described above with reference to Figure **1**, AV data is recorded to the searched free area while skipping defective sectors (step **B4**). In order to manage the location information where AV data is recorded, the location information of an area in which only AV data is recorded is registered as an AV extent, the location information of a skipped ECC block is registered as a defective extent, and the location information of an area in the terminal portion of the file where padding data for completing the ECC block is recorded is registered as a padding extent, respectively in the file management information (step **B5**). In **C3** of Figure 3, extents **A**, **B** and **C** are each an area where AV data is recorded, extent **S** is an area which has been skipped because of a defective sector detected therein, and extent **E** is an area in the terminal portion of the file where padding data is recorded. The respective extents are registered, as illustrated in **C7**, as separate allocation descriptors in the file entry (**C6**) of the AV file. Then, attribute information is registered in the file entry, in which an AV attribute bit is set indicating that the recorded file is an AV file (step **B6**). In **C6** of Figure 3, the AV attribute bit is set as a contiguous bit defined in the ICB tag. Finally, in order to set the area where the AV file is recorded as allocated, bits corresponding to extents **A**, **S**, **B**, **C** and **E** in the space bit map are set to 0 indicating allocated (step **B7**). For example, in **C5** of Figure **3**, bits from bit 7 in byte 73 to bit 7 in byte 445 and bits from bit 0 in byte 486 to bit 7 in byte 799 are set to 0. By providing such a data structure, it is determined whether the reproduced file is an AV file or not from the file attribute information shown in Figure **26**. Then, if the file is an AV file, the reproduction operation can be performed only using the location information of the AV extent registered in the file entry while neglecting the defect management information recorded in the defect management area. In the data reproduction operation, extent **S** and extent **E** are not used since no AV data is recorded therein.

Hereinafter, referring to Figure **12**, the data structure of a disk in which a computer file and an AV file are mixedly recorded will be described. If the sector at LBN 3586 which is assigned for recording file **B**, a computer file, is a defective sector, the ECC block (LBNs 3584 to 3599) including the defective sector is recorded in a spare area, and the defect management information is recorded in the defect management area. Herein, since the replacement recording is performed by ECC blocks, the file entry of file **B** and a portion of file **A** are simultaneously recorded in the spare area. If file **A** is an AV file, and a portion of the AV data included in the AV file is recorded in the same ECC block where a computer file is recorded, then, the AV data will also be recorded in the spare area. In order that AV data and computer data are not mixedly recorded in an ECC block, an AV file is allocated to align with an ECC block boundary, as illustrated in Figure **12**. Thus, each AV file starts from the leading sector in an ECC block, and defective sectors are skipped by ECC blocks, while a padding extent filled with padding data is allocated to each sector where AV data is not recorded so that the AV file allocation is made up to the end of the ECC block. By providing such a data structure, a continuous reproduction operation for AV data is ensured without accessing any spare area.

Hereinafter, referring to Figure **13**, an example of a method for managing free areas in AV file recording will be described. As described above with reference to Figure **9**, a free area for recording an AV file is first searched for. Then, the first continuous area at LBNs 592 to 3567 and the second continuous area at LBN 3888 to the end are assigned as the free area. Subsequently, an AV reserved file is created by recording a file entry in which these free areas are managed as allocated and unrecorded extents. At the same time, the area in which the file entry is recorded and the two allocated continuous areas are registered in the space bit map as allocated. An AV file is recorded, by the method described above with reference to Figure **1**, from the beginning of the allocated extent which has been previously registered in the AV reserved file. When these free areas are allocated as areas for recording the AV reserved file, in advance of the AV data recording, even if a recording operation for an AV file and a recording operation for a computer file are performed in parallel in a multi-task environment, the computer file is assigned to a remaining unallocated area, whereby it is possible to prevent the AV data and data of a computer file from being erroneously assigned in the same ECC block.

(3) DATA REPRODUCTION METHOD

Hereinafter, a method for reproducing an AV file according to the present invention will be described, along with a reproduction operation for file management information.

Figure **14** is a flow chart illustrating a method for reproducing an AV file. First, the AV attribute bit is read out from the file entry of a file to be reproduced (step **D1**). The AV attribute bit is included in the ICB tag, as illustrated in C6 of Figure **3**. As described above, the AV attribute bit is a contiguous bit described in Figure **26** and is attribute information for determining whether an AV file or not. This bit being 1 indicates an AV file, while this bit being 0 indicates a non-AV file such as a computer file. Based on the value of the AV attribute bit, it is determined whether the file is an AV file or not (step **D2**). Then, if the file is a computer file, it is read out by the conventional method for computer files (step **D3**). On the other hand, in the case of an AV file, an allocation descriptor field registered in the file entry of the AV file is read out, and the location information of the respective AV extents included in the AV file is sequentially read out (step **D4**). Moreover, the reproduction apparatus is instructed to read out AV data from each AV extent (step **D5**). Herein, the reproduction apparatus continuously reads out only AV data from the AV extents while neglecting the replacement sector information registered in the defect list on the disk and while performing no recovery operation even when an address error or a data error is detected during a reproduction operation (step **D6**). Finally, it is determined whether the AV data has been reproduced from all the AV extents included in the AV file (step **D7**). Then, if there is an unreproduced AV extent, steps **D5** and **D6** are repeated again. By performing such a reproduction operation, the AV file which has been recorded by the method of Figure **1** is continuously reproduced while the video or the sound is not interrupted.

Although the recording/reproduction operations of the present invention have been described with a DVD-RAM disk, it is apparent that similar recording/reproduction operations can be performed with, for example, a magnetic disk or a magneto-optical disk, as long as it is a recording medium with a large capacity on which an AV file can be recorded.

For simply illustrating the data recording operation for the DVD-RAM disk in which an ECC block is composed of a plurality of sectors, it is assumed in the above description that the entire ECC block including a defective sector is skipped. However, it is apparent that it is possible to similarly perform a data reproduction method in which only the defective sector, rather than the entire ECC block, is skipped. Moreover, the defective sector is skipped by sectors also in the case where the ECC block has the same size as the sector size.

Although the present invention has been described while assuming that the AV extent, the defective extent and the padding extent are each identified using a portion of an allocation descriptor described in Figure **11B**, it is apparent that the extent attribute identification is not limited to such attribute information, but can be assigned to another descriptor, another bit, or the like. For example, it is also possible to define a data structure of a new allocation descriptor and to provide a field indicating the extent attribute information.

The padding extent is not limited to those provided in the terminal portion of a file. For example, when the size of the AV extent is reduced while editing an AV file, the area in the AV extent in which AV data is no longer recorded may be registered as a new padding extent. In such a case, the padding extent is allocated in a leading portion or an intermediate portion of the file.

In the above description of the present invention, an area including a defective sector detected during a recording operation for an AV file is registered as a defective extent. Other than such a method, it is possible, for example, to define a special file for managing a defective extent and the file attribute information thereof so as to assign and manage a file which is composed only of defective extents.

Although a space bit map has been used as information for managing unallocated areas on the disk in the above description, they can also be managed by using a space table.

Although the present invention has been described while assuming the size of a continuous free area allocated for recording an AV file to be 5 MB or larger, it is obvious that the size may differ depending upon the buffer capacity, the access performance, or the like, of the reproduction apparatus.

Although an AV reserved file is registered for allocating a continuous free area for recording an AV file in the above description of the present invention, it is also possible to previously allocate a continuous free area using a new bit map, a table, or the like.

When reproducing AV data from AV extents by the reproduction method of the present invention, it is obvious that continuous data reproduction can be more reliably performed if the reproduction apparatus reads ahead the AV data while storing the AV data in cache during reproduction.

(Embodiment 2)

Hereinafter, an information processing system including a recording/reproduction apparatus for recording/reproducing data to/from the above-described DVD-RAM disk and a control device for controlling the same will be described as Embodiment 2 of the present invention.

Figure **15** is a block diagram illustrating a structure of the information processing system of the present invention.

R1 denotes a control section; **R2** denotes an MPEG encoder; **R3** denotes a disk recording/reproduction drive; **R4** denotes an MPEG decoder; **R5** denotes a video signal processing section; **R6** denotes a hard disk drive; **R7** denotes an I/O bus; **R8** denotes an input section; **R9** denotes a rewritable phase change type optical disk; and **R10** denotes a receiver.

The control section **R1** includes a CPU **R1a**, a main memory **R1d**, a bus interface **R1c** and a processor bus **R1b**. Based on a program stored in the main memory **R1d**, the control section **R1** performs an AV file identification process, a read out location indication process, a recording area searching process, a process for calculating the acceptable number of skips and a file system information creation process, as illustrated in Figure **20A**.

The disk recording/reproduction drive R3 includes: a microprocessor **R3d** for controlling the entire drive; a bus control circuit **R3a** for controlling transmission/reception of a command or data to/from the control section **R1** via an IDE (Intelligent Drive Electronics) bus; a data recording/reproduction/verification section **R3e** for performing data reproduction including data recording and data verification operations to the phase change type optical disk **R9**; a buffer section R3b for temporarily storing recording data, reproduction data, and data read out for data verification; and a buffer control section **R3c** for controlling data transfer of the buffer section. The microprocessor **R3d** performs a skip recording control operation, as illustrated in Figure **20B**.

The phase change type optical disk **R9** is the DVD-RAM disk as described above in Embodiment **1**.

Hereinafter, the operation of recording AV data received by the receiver **R10** via a broadcast wave to the phase change type optical disk R9 will be described with reference to Figure **16**. Herein, it is assumed that the file system information recorded on the phase change type optical disk **R9** has already been read out and stored in the main memory **R1d** in the control section.

Figure **16** illustrates a protocol used between the control section **R1** and the disk recording drive **R3** in an operation for recording AV data, which is moving image information received by the receiver **R10** via a broadcast wave, to the phase change type optical disk **R9**.

(P101) The recording area searching process by the control section **R1** selects a continuous free area for recording an AV file by referring to the file system information which is previously read out and stored in the main memory **R1d** when the phase change type optical disk **R9** is mounted. In the process for calculating the acceptable number of skips, the number of ECC blocks which can be skipped by the disk recording drive **R3** is calculated from the file system information.

(P102 to P103) The control section **R1** issues "SKIP WRITE AV (ADR, LEN, SKIP_LEN)" as a command to record AV data while skipping the ECC block including the defective sector detected by the recording drive R3. Herein, the parameter ADR denotes the starting address of data recording; LEN denotes the number of blocks to be recorded; and SKIP_LEN denotes the maximum value for the number of ECC blocks to be skipped (hereinafter, referred to as the "acceptable number of skips"). When receiving the "SKIP WRITE AV", the disk recording drive **R3** starts a recording operation for AV data transferred.

(P104) When a defective sector having an address error is detected while the disk recording drive **R3** is recording AV data, the ECC block including the defective sector is regarded as a defect ECC block. Then, the starting address of the ECC block is internally stored, and a data recording operation is performed to the following ECC block.

(P105) When the disk recording drive **R3** detects a defect ECC block, and the defect ECC block is accordingly skipped, if the preset acceptable number of skips is exceeded, the disk recording drive **R3** stops the data recording operation, while reporting an error status to the control section **R1** and returning detailed error information (Skip Sector Over) to the control section **R1**, indicating that the acceptable number of skips is exceeded. On the other hand, when all AV data has been recorded without performing a skip operation, the disk recording drive **R3** returns a normal completion status to the control section **R1**. Moreover, when all AV data has been recorded with skip operations within the specified acceptable number of skips, the disk recording drive **R3** returns to the control section **R1** detailed error information (Recovered Error), indicating that the recording has been performed with skip operations within the skip sector number, along with the error status.

(P106) When receiving the detailed error information indicating Recovered Error, the control section **R1** issues a command "SEND SKIPPED SECTOR", requesting the address information of the skipped ECC blocks.

(P107) Address information of all the defect ECC blocks which have been stored during the recording operation is transferred to the control section **R1**, when the disk recording drive **R3** receives the "SEND SKIPPED SECTOR" command.

Hereinafter, the reproduction operation for an AV file recorded on the phase change type optical disk **R9** will be described with reference to Figure **17**.

Figure **17** illustrates a protocol used between the control section **R1** and the disk reproduction drive **R3** in an operation for reproducing the AV data recorded on the phase change type optical disk **R9**.

(P201) The control section **R1** determines, from the file system information, that the file requested to be read out is an AV file.

(P202) The control section **R1** issues a "READ AV" command, requesting to read out AV data from AV extents included in the AV file.

(P203 to P204) When receiving the "READ AV" command, the disk reproduction drive **R3** continuously performs a data reproduction operation without referring to the defect list, and continues the data reproduction operation even when an address error or a data error occurs. Then, the disk reproduction drive **R3** transfers the reproduced data to the control section **R1**.

(P205) The control section **R1** sequentially transfers the read out data to the MPEG decoder **R4**, thereby outputting an analog AV signal via a monitor display and a loudspeaker.

(P206) The disk reproduction drive **R3** transfers a normal completion status to the control section **R1**.

According to the present embodiment, even if a defective sector is detected during a data recording operation, the data is recorded in the following ECC block while skipping the ECC block including the defective sector, whereby it is possible to record in real time AV data received via a broadcast wave, which requires real time recording. Moreover, in the data reproduction operation, it is not necessary to access the spare area as in the linear replacement algorithm; therefore it is possible to ensure continuous video or sound reproduction.

In the present embodiment, when a different file is recorded following the area allocated for recording an AV file, in order to prevent the area, where the following file is recorded, from being overwritten by AV data, the disk recording drive is allowed to skip ECC blocks within the acceptable number of skips. However, in the case where no valid file is recorded in the following area, it is neither necessary to limit the acceptable number of skips nor to calculate the acceptable number of skips.

Although, in the present embodiment, the number of ECC blocks allowed to be skipped during a recording operation for AV data is set in the disk recording drive **R3**, the present invention is not limited to such a method. For example, it is apparent that, by previously setting the terminal address of the area where AV data can be recorded, the disk recording drive **R3** is able to perform the recording operation while skipping ECC blocks within the area up to the terminal address, thereby obtaining the effect of the present invention.

(Embodiment 3)

Next, an information processing system including a recording/reproduction apparatus for recording/reproducing data to/from the above-described DVD-RAM disk and a control device for controlling the same will be described as Embodiment 3 of the present invention. The difference from Embodiment 2 above is that AV data is input via the internet, rather than a broadcast wave. Accordingly, the real time recording is not performed, but the more reliable asynchronous recording is performed.

Figure **18** is a block diagram illustrating a structure of the information processing system of the present invention.

N1 denotes a control section; **N2** denotes a network card; **N3** denotes a disk recording/reproduction drive; **N4** denotes an MPEG decoder; **N5** denotes a video signal processing section; **N6** denotes a hard disk drive; **N7** denotes an I/O bus; **N8** denotes an input section; **N9** denotes a rewritable phase change type optical disk; **N10** denotes the internet; and **N11** denotes a server.

The structure of the control section **N1** is identical to that of the control section **R1** illustrated in Figure **15**. The control section **N1** operates based on a program stored in a main memory **N1d**, performing an AV file identification process, a read out location indication process, a recording area searching process, a recording control process and a file system information creation process, as illustrated in Figure **21**.

The structure of the disk recording/reproduction drive **N3** is identical to that of the disk recording/reproduction drive **R3** illustrated in Figure **15**.

The phase change type optical disk **N9** is the DVD-RAM disk as described above in Embodiment 1.

Hereinafter, an operation of recording, to the phase change type optical disk **N9** via the network card **N2**, AV data transferred from the server **N11** via the internet **N10** will be described with reference to Figure **18**. Herein, it is assumed that the file system information on the phase change type optical disk N9 has already been read out and stored in the main memory **N1d** in the control section **N1**. The network card N2 is connected to the internet **N10**, thus receiving data sent from the server **N11**.

Figure **19** illustrates a protocol used between the control section **N1** and the disk recording drive **N3** in an operation for asynchronously recording AV data received via the internet **N10** to the phase change type optical disk **N9**.

(P301) The recording area searching process by the control section **N1** selects a continuous free area for recording an AV file by referring to the file system information which has been previously read out.

(P302) The recording control process by the control section **N1** issues a "WRITE & VERIFY AV (ADR2, LEN2)" command, requesting to record AV data to the area selected in **(P301)**. Herein, the parameter ADR denotes the starting address of data recording; and LEN denotes the number of blocks to be recorded. The "WRITE & VERIFY AV" command requests to neglect the defect list and to return the error status and the address information of the defective sector without performing a replacement operation when a defective sector is detected during the recording operation.

(P303) The recording control process by the control section **N1** transfers, to the disk recording drive **N3**, the AV data to be recorded at the "WRITE AV" command.

(P304 to P306) The disk recording drive **N3** continuously records AV data in the specified area without referring to the defect list. When detecting a defective sector having an address error, a data error, or the like, during the recording operation for AV data, the disk recording drive **N3** does not perform a replacement operation but stops the recording operation, and returns the error status and the defective sector address information to the control section **N1**.

(P307) The control section **N1** stores the address information of the defective sector in the main memory **N1d**.

(P308 to **P309)** The recording control process by the control section **N1** issues "WRITE & VERIFY AV (ADR3, LEN3)" command, while setting the ECC block following the ECC block including the defective sector as the starting address based on the address information stored in **(P308)**, so as to resend the unrecorded data (including data to be recorded in the ECC block including the defective sector) to the disk recording drive **N3**.

(P310 to **P311)** The disk recording drive **N3** continuously records AV data in the specified area without referring to the defect list based on the newly-set starting address. When completing the specified data recording operation without an error, the disk recording drive **N3** returns a normal completion status to the control section **N1**.

In advance of the recording operation for AV data described above with reference to Figure 19, the control section **N1** issues a command "READ (ADR1, LEN1)" for requesting to read out the file system information so as to refer to free areas on the phase change type optical disk **N9**. Herein, the "READ" command requests to read out a number of blocks as specified by LEN starting from the sector having the address specified by the first parameter ADR, while performing a replacement operation using the defect list. When receiving the "READ" command, the disk recording drive **N3** reads out the specified file system information referring to the defect list. Thus, when there is a defect block in the area where the file system information is recorded, data reproduction is performed by an ECC unit from an alternate block assigned in a spare area. The disk recording drive **N3** transfers the file system information read out from the phase change type optical disk **N9** to the control section **N1**.

After completing the recording operation for AV data described above with reference to Figure 19, the file system information creation process by the control section **N1** registers the ECC block including the defective sector stored in **(P307)** as a defective extent and continuous areas where AV data of the AV file is recorded as an AV extent. Moreover, in the space bit map, bits for managing the respective sectors in the area, where the defective extent and the AV extent are allocated, are registered as allocated.

The file system information creation process by the control section **N1** requests, by a "WRITE & VERIFY (ADR4, LEN4)" command, the disk recording drive **N3** to register the file system information updated by the file system information creation process. Herein, the "WRITE & VERIFY" command is a command to verify that the data can be reproduced under a condition more severe than that for normal reproduction after the completion of the data recording operation. The command requests, when a defective sector is detected in both the recording process and the verification process, to register it in the defect list and to perform a replacement process. When there is an ECC block including an already-detected defective sector in the specified recording area, it requests to record the ECC block in the replacement destination and to perform a verification operation for the recorded ECC block. Then, the disk recording drive **N3** performs the specified data recording and verification processes while controlling a data recording/verification section **N3e** with reference to the defect list. After normally processing the "WRITE & VERIFY" command, the disk recording drive **N3** returns the normal completion status to the control section **N1**.

The recording operation for an AV file has been described hitherto. The description of the reproduction operation for the AV file is omitted as it is the same as that in Embodiment 2.

As described above, according to the present embodiment, the recorded sector is tested after AV data has been recorded in order to improve the reliability of the recorded data, whereby it is possible to ensure uninterrupted reproduction of a video or a sound during data reproduction while ensuring the same reliability of data as that ensured by the conventional recording method.

A combination of a control mainly for the disk recording drive (Figure **16**) and a structure of the analog video receiving section and the MPEG encoder (Figure **15**) has been described in Embodiment 2, while a combination of a control mainly for the control section (e.g., a personal computer) (Figure **19**) and a structure of the digital interface and the digital video retrieving section (Figure **18**) has been described in Embodiment 3. However, the present invention is not limited to such a particular system structure. The control mainly for the disk recording drive (Figure **16**) may be combined with the structure of the digital interface and the digital video retrieving section (Figure **18**), while the control mainly for the control section (e.g., a personal computer) (Figure **19**) may be combined with the structure of the analog video receiving section and the MPEG encoder (Figure **15**).

INDUSTRIAL APPLICABILITY

According to the present invention, even if a defective sector is detected while recording AV data, the following ECC block data is recorded while skipping the ECC block including the defective sector. Thus, an access to the spare area is not required at all, whereby it is possible to record in real time AV data to an information recording disk and to continuously reproduce the AV data recorded on the information recording disk.

Moreover, according to the present invention, it is possible to verify whether or not the AV data recorded on the information recording disk has been properly recorded. Thus, it is possible to ensure uninterrupted reproduction of a video or a sound during data reproduction while ensuring the same reliability of data as that ensured by the conventional recording method.

Claims

1. A recording method for recording an AV file including AV data using an information recording disk in which data is recorded/reproduced by sectors, the recording method comprising the steps of: determining whether or not input data is AV data; detecting a defective sector existing in a data recording area assigned for recording the input data; when it is determined that the input data is the AV data and a defective sector is detected in the data recording area, allocating a defective extent including the defective sector; recording the AV data in continuous sectors while skipping the defective extent; and allocating an area of continuous sectors where only the AV data is recorded as one AV extent, wherein an AV file is recorded on the information recording disk, wherein the AV file includes: a defective extent, which includes, when a defective sector is included in the data recording area, the defective sector; and one or more AV extents each including a plurality of continuous sectors.

2. A recording method according to claim 1, wherein only a sector where an address error is detected during a data recording operation is detected as the defective sector.

3. A recording method according to claim 1, wherein the defective sector comprises a sector where an address error is detected during a data recording operation and a sector where a data error is detected during a data verification operation.

4. A recording method according to claim 1, wherein when using an information recording disk where an ECC block has a plurality of sectors, the defective extents are allocated by ECC blocks.

5. A recording method according to claim 1, wherein when using an information recording disk where an ECC block has a plurality of sectors, the method further comprises the step of allocating, in the AV file, a padding extent which does not include AV data.

6. A recording method according to claim 1, further comprising the step of recording attribute information for identifying the AV file including AV data, as part of file management information.

7. A recording method according to claim 1, further comprising the step of recording attribute information for identifying the defective extent and the AV extent, as part of file management information, in such a format that the attribute information is in one-to-one correspondence with the respective extents forming an AV file.

8. A recording apparatus for recording AV data on an information recording disk in which data is recorded/reproduced by sectors, the recording apparatus comprising: a section for determining whether or not input data is AV data; a section for detecting a defective sector existing in a data recording area assigned for recording the input data; and a section for recording the AV data in continuous sectors while skipping the defective sector, wherein AV data is recorded in a plurality of continuous sectors on the information recording disk while skipping a defective sector existing in the data recording area.

9. A recording apparatus according to claim 8, wherein only a sector where an address error is detected during a data recording operation is detected as the defective sector.

10. A recording apparatus according to claim 8, wherein the defective sector comprises a sector where an address error is detected during a data recording operation and a sector where a data error is detected during a data verification operation.

11. A recording apparatus according to claim 8, wherein when using an information recording disk where an ECC block has a plurality of sectors, the defective sectors are skipped by ECC blocks each including the defective sector.

12. An information processing system, comprising: the recording apparatus according to claim 8; and a control device for controlling the recording apparatus, the information processing system comprising: a section for allocating, in recording of an AV file, a defective sector detected by the recording apparatus as a defective extent; and a section for allocating continuous sectors where only AV data is recorded by the recording apparatus as an AV extent, wherein an AV file is recorded on the information recording disk, the AV file including: a defective extent, which includes, when a defective sector is included in the data recording area, the defective sector; and one or more AV extents each including a plurality of continuous sectors.

13. An information processing system according to claim 12, wherein when using an information recording disk where an ECC block has a plurality of sectors, the control device allocates the defective extent by ECC blocks each including a defective sector.

14. An information processing system according to claim 12, wherein when using an information recording disk where an ECC block has a plurality of sectors, the control device further comprises a section for allocating a padding extent which does not include AV data, as part of the AV file.

15. An information processing system according to claim 12, wherein the control device further comprises a section for recording attribute information for identifying the AV file including AV data, as part of file management information.

16. An information processing system according to claim 12, wherein the control device further comprises a section for recording attribute information for identifying the defective extent and the AV extent, as part of file management information, in such a format that the attribute information is in one-to-one correspondence with the respective extents forming an AV file.

17. An information processing system according to claim 12, wherein: the control device comprises a section for setting in the recording apparatus an acceptable value for the total number of sectors skipped when a defective sector is detected during a recording operation for AV data; and the recording apparatus comprises a section for, after AV data has been recorded while skipping defective sectors within a range not exceeding the acceptable value, informing the control device of location information of all the sectors skipped during a recording operation for AV data.

18. An information processing system according to claim 12, wherein: the recording apparatus comprises a section for, each time a defective sector is detected during a recording operation for AV data, informing the control section of the detection of the defective sector along with location information of the defective sector; and the control section comprises a section for setting in the recording apparatus a new recording start location for AV data each time the detection of the defective sector is informed.

19. A reproduction method for performing data reproduction from the information recording disk on which the AV file is recorded using the recording method according to claim 1, the method comprising the step of, in an AV data reproduction operation from the AV extent, performing a continuous data reproduction operation while neglecting location information of a replacement-recorded defective sector and not performing a recovery process even when an error occurs during data reproduction.

20. A reproduction apparatus for performing data reproduction from the information recording disk on which the AV file is recorded using the recording method according to claim 1, the apparatus comprising a section for, in an AV data reproduction operation from the AV extent, performing a continuous data reproduction operation while neglecting location information of a replacement-recorded defective sector and not performing a recovery process even when an error occurs during data reproduction.

21. An information recording disk in which an AV file including AV data is recorded/reproduced by sectors, wherein the AV file includes: a defective extent, which includes, when a defective sector is included in the data recording area assigned for file recording, the defective sector; and one or more AV extents recorded in a plurality of continuous sectors where only the AV data is recorded.

22. An information recording disk according to claim 21, wherein only a sector where an address error is detected during a data recording operation is regarded as the defective sector.

23. An information recording disk according to claim 21, wherein the defective sector comprises a sector where an address error is detected during a data recording operation and a sector where a data error is detected during a data verification operation.

24. An information recording disk according to claim 21, wherein when using an information recording disk where an ECC block has a plurality of sectors, the defective extents are allocated by ECC blocks.

25. An information recording disk according to claim 21, wherein when using an information recording disk where an ECC block has a plurality of sectors, the AV file comprises a padding extent which does not include AV data.

26. An information recording disk according to claim 21, wherein attribute information for identifying the AV file including AV data is further recorded as part of file management information.

27. An information recording disk according to claim 21, wherein attribute information for identifying the defective extent and the AV extent is further recorded, as part of file management information, in such a format that the attribute information is in one-to-one correspondence with the respective extents forming an AV file.

Amended claims under Art. 19.1 PCT

1. (amended) A recording method for recording file management information and data including AV data on an information recording disk, wherein the file management information is for managing continuous sectors as an extent and for further managing one or more extents as a file by grouping one or more extents, the recording method comprising the steps of:

determining whether or not input data is AV data;
determining whether or not a defective sector is included in a data recording area assigned for recording the input data;
when it is determined that the input data is the AV data and it is determined that the defective sector is included in the data recording area, skipping at least the defective sector and recording the AV data in one or more continuous sectors following the skipped one or more sectors; and
registering the recorded file of AV data in the file management information, the file of AV data registered in the file management information including the one or more continuous sectors where the AV data is recorded as an AV extent and further including the skipped one or more sectors as a defective extent.

2. (amended) A recording method according to claim 1, wherein the defective sector is a sector where an address error is detected during a data recording operation.

3. (amended) A recording method according to claim 1, wherein the defective sector comprises a sector where an address error is detected during a data recording operation and a sector where a data error is detected during a data verification operation.

4. (amended) A recording method according to claim 1, wherein the skipped one or more sectors comprise a plurality of sectors forming one or more ECC blocks.

5. (amended) A recording method according to claim 1, wherein the file of AV data registered in the file management information includes one or more continuous sectors from an end of the AV extent to an ECC block boundary as a padding extent.

6. (amended) A recording method according to claim 1, further comprising the step of registering identification information for identifying a file which includes the AV data in the file management information.

7. (amended) A recording method according to claim 1, further comprising the step of registering identification information for identifying the defective extent and the AV extent in the file management information.

8. (amended) An information processing system, comprising:

a recording apparatus for recording file management information and data including AV data on an information recording disk, wherein the file management information is for managing continuous sectors as an extent and for further managing one or more extents as a file by grouping one or more extents; and
a control device for controlling the recording apparatus,
the recording apparatus comprising:

a section for determining whether or not input data is AV data;
a section for determining whether or not a defective sector is included in a data recording area assigned for recording the input data; and
a section for, when it is determined the input data is the AV data and it is determined that the defective sector is included in the data recording area, skipping at least the defective sector and recording the AV data in one or more continuous sectors following the skipped one ore more sectors,
the control device comprising:

a section for registering the recorded file of AV data in the file management information, wherein:
the file of AV data registered in the file management information is a file including the one or more continuous sectors where the AV data is recorded as an AV extent and further including the skipped one or more sectors as a defective extent.

9. (amended) An information processing system according to claim 8, wherein the defective sector is a sector where an address error is detected during a data recording operation.

10. (amended) An information processing system according to claim 8, wherein the defective sector comprises a sector where an address error is detected during a data recording operation and a sector where a data error is detected during a data

verification operation.

11. (cancelled)

12. (cancelled)

13. (amended) An information processing system according to claim 8, wherein the skipped one or more sectors comprise a plurality of sectors forming one or more ECC blocks.

14. (amended) An information processing system according to claim 8, wherein the file of AV data registered in the file management information includes one or more continuous sectors from an end of the AV extent to an ECC block boundary as a padding extent.

15. (amended) An information processing system according to claim 8, wherein the control device further comprises a section for registering identification information for identifying a file which includes the AV data in the file management information.

16. (amended) An information processing system according to claim 8, wherein the control device further comprises a section for registering identification information for identifying the defective extent and the AV extent in the file management information.

17. (amended) An information processing system according to claim 8, wherein:

> the control device further comprises a section for setting a maximum acceptable value for a number of sectors which can be skipped by the recording apparatus; and
> the recording apparatus further comprises a section for skipping one or more continuous sectors including the defective sector within a range not exceeding the maximum acceptable value, and informing the control device of information indicating locations of the one or more skipped sectors.

18. (amended) An information processing system according to claim 8, wherein:

> the recording apparatus further comprises a section for informing the control device of information indicating a location of the defective sector each time the defective sector is detected during a data recording operation; and
> the control device further comprises a section for setting in the recording apparatus a recording start location for the AV data based on the information indicating the location of the defective sector informed by the recording apparatus.

19. (amended) A reproduction method for reproducing data from the information recording disk on which the AV data is recorded using the recording method according to claim 1, the reproduction method comprising the step of reproducing the AV data from the AV extent without referring to location information of the defective sector.

20. (amended) A reproduction apparatus for reproducing data from the information recording disk on which the AV data is recorded using the recording method according to claim 1, the reproduction apparatus comprising a section for reproducing the AV data from the AV extent without referring to location information of the defective sector.

21. (amended) An information recording disk on which file management information and data including AV data are recorded, wherein the file management information is for managing continuous sectors as an extent and for further managing one or more extents as a file by grouping one or more extents, wherein:

> when the input data is AV data while a defective sector is included in a data recording area assigned for recording the input data, the AV data is recorded in one or more continuous sectors following the skipped sector including the defective sector; and
> a file including the one or more continuous sectors where the AV data is recorded as an AV extent while including the skipped sector as a defective extent is registered in the file management information.

22. (amended) An information recording disk according to claim 21, wherein the defective sector is a sector where an address error is detected during a data recording operation.

23. (amended) An information recording disk according to claim 21, wherein the defective sector comprises a sector where an address error is detected during a data recording operation and a sector where a data error is detected during a data verification operation.

24. (amended) An information recording disk according to claim 21, wherein the skipped one ore more sectors comprise a plurality of sectors forming one or more ECC blocks.

25. (amended) An information recording disk

according to claim 21, wherein the file of AV data registered in the file management information includes one or more continuous sectors from an end of the AV extent to an ECC block boundary as a padding extent.

26. (amended) An information recording disk according to claim 21, wherein identification information for identifying a file which includes the AV data is further registered in the file management information.

27. (amended) An information recording disk according to claim 21, wherein identification information for identifying the defective extent and the AV extent is further registered in the file management information.

28. (added) A recording method according to claim 1, further comprising the steps of:

prior to recording the AV data to the information recording disk, detecting one or more continuous sectors in which the AV data can be recorded; and
registering in the file management information an AV recording file including the detected one or more continuous sectors as an unrecorded extent, wherein:
the AV data is recorded in one or more of the continuous sectors assigned for the unrecorded extent of the AV recording file.

29. (added) An information processing system according to claim 8, further comprising:

a section for, prior to recording the AV data to the information recording disk, detecting one or more continuous sectors in which the AV data can be recorded; and
a section for registering in the file management information an AV recording file including the detected one or more continuous sectors as an unrecorded extent, wherein:
the AV data is recorded in one or more of the continuous sectors assigned for the unrecorded extent of the AV recording file.

FIG. 1

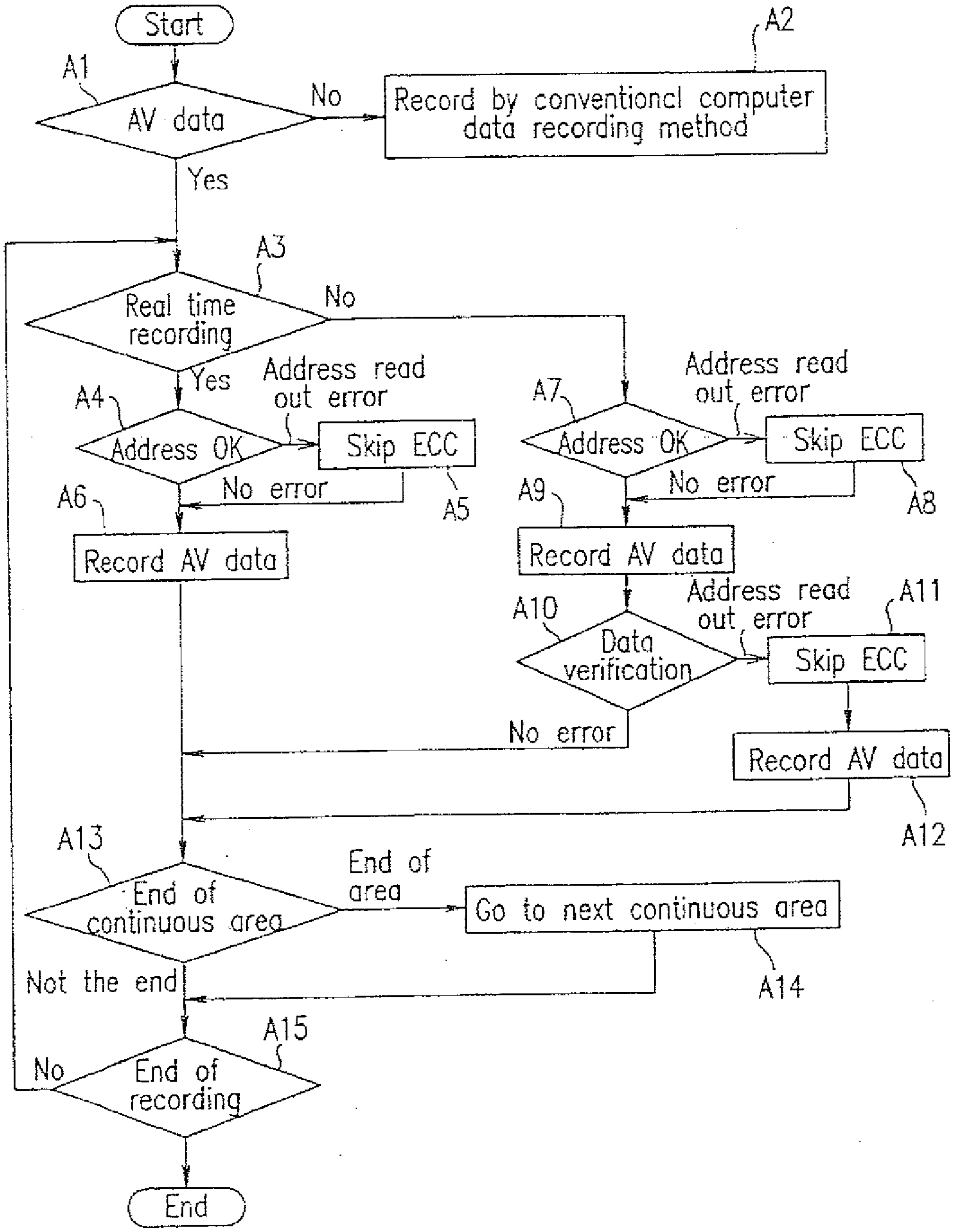

Start
A1
AV data
No
A2
Record by conventional computer data recording method
Yes
A3
Real time recording
No
Yes
A4
Address OK
Address read out error
Skip ECC
No error
A5
A6
Record AV data
A7
Address OK
Address read out error
Skip ECC
No error
A8
A9
Record AV data
A10
Data verification
Address read out error
A11
Skip ECC
No error
Record AV data
A12
A13
End of continuous area
End of area
Go to next continuous area
A14
Not the end
A15
No
End of recording
End

FIG. 2

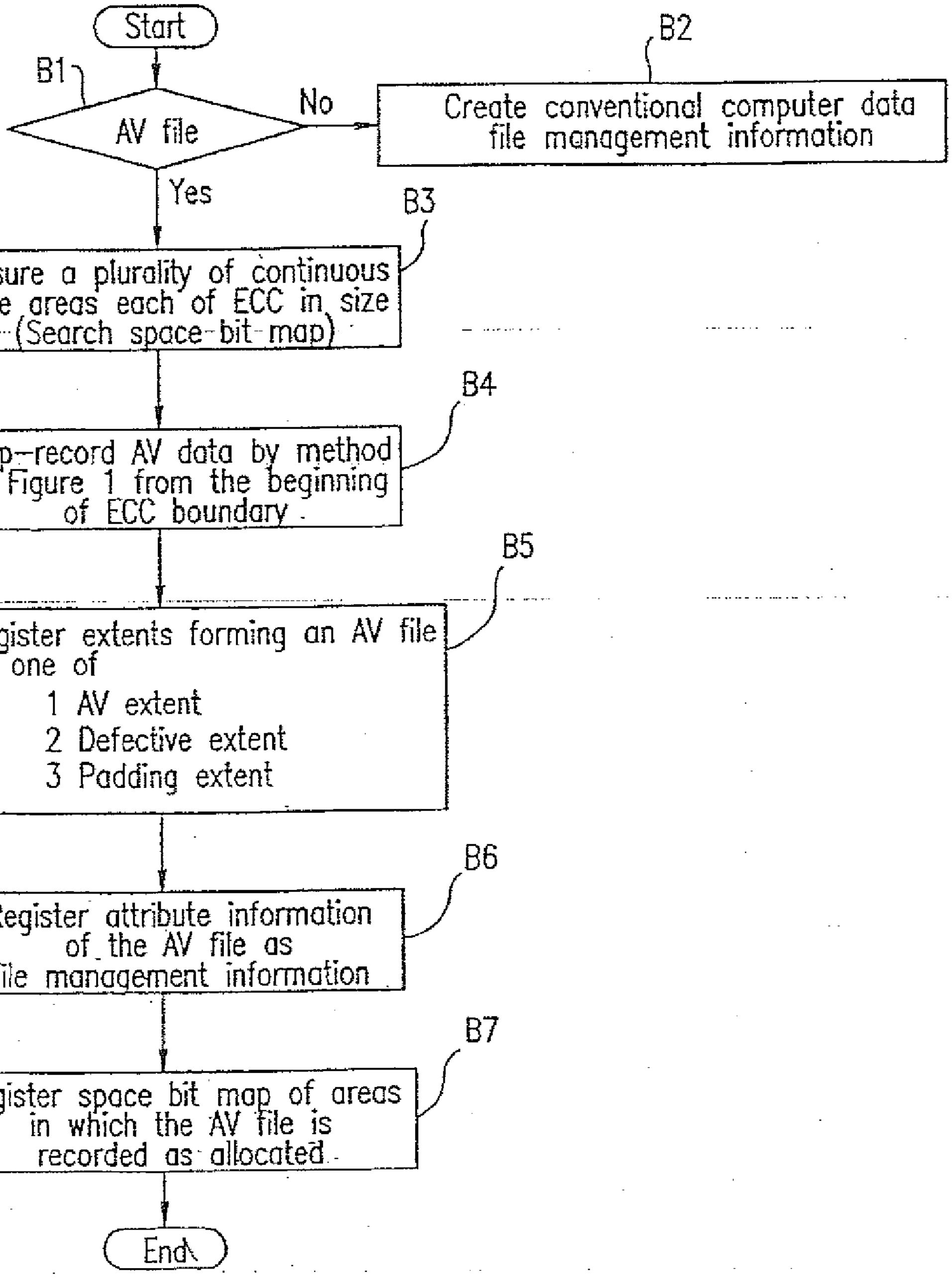
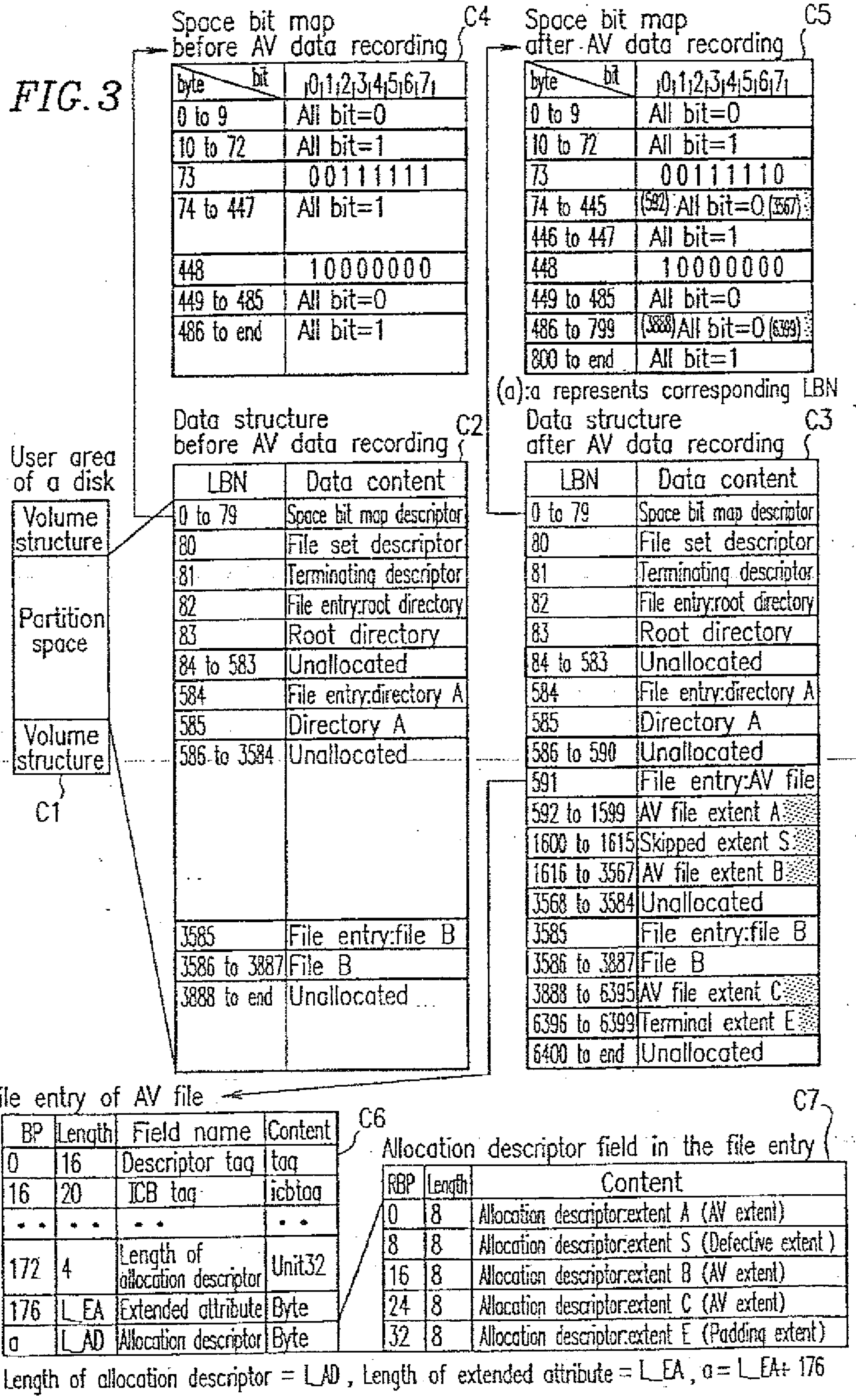

Start
B1
AV file
No
Yes
B2
Create conventional computer data file management information
B3
Ensure a plurality of continuous free areas each of ECC in size (Search space bit map)
B4
Skip-record AV data by method of Figure 1 from the beginning of ECC boundary
B5
Register extents forming an AV file as one of
1 AV extent
2 Defective extent
3 Padding extent
B6
Register attribute information of the AV file as file management information
B7
Register space bit map of areas in which the AV file is recorded as allocated
End

FIG. 3



Space bit map before AV data recording

byte \ bit	0 1 2 3 4 5 6 7
0 to 9	All bit=0
10 to 72	All bit=1
73	00111111
74 to 447	All bit=1
448	10000000
449 to 485	All bit=0
486 to end	All bit=1

Space bit map after AV data recording

byte \ bit	0 1 2 3 4 5 6 7
0 to 9	All bit=0
10 to 72	All bit=1
73	00111110
74 to 445	(592) All bit=0 (3567)
446 to 447	All bit=1
448	10000000
449 to 485	All bit=0
486 to 799	(3888) All bit=0 (6399)
800 to end	All bit=1

(a):a represents corresponding LBN

Data structure before AV data recording

LBN	Data content
0 to 79	Space bit map descriptor
80	File set descriptor
81	Terminating descriptor
82	File entry:root directory
83	Root directory
84 to 583	Unallocated
584	File entry:directory A
585	Directory A
586 to 3584	Unallocated
3585	File entry:file B
3586 to 3887	File B
3888 to end	Unallocated

Data structure after AV data recording

LBN	Data content
0 to 79	Space bit map descriptor
80	File set descriptor
81	Terminating descriptor
82	File entry:root directory
83	Root directory
84 to 583	Unallocated
584	File entry:directory A
585	Directory A
586 to 590	Unallocated
591	File entry:AV file
592 to 1599	AV file extent A
1600 to 1615	Skipped extent S
1616 to 3567	AV file extent B
3568 to 3584	Unallocated
3585	File entry:file B
3586 to 3887	File B
3888 to 6395	AV file extent C
6396 to 6399	Terminal extent E
6400 to end	Unallocated

File entry of AV file

BP	Length	Field name	Content
0	16	Descriptor tag	tag
16	20	ICB tag	icbtag
• •	• •	• •	• •
172	4	Length of allocation descriptor	Unit32
176	L_EA	Extended attribute	Byte
a	L_AD	Allocation descriptor	Byte

Allocation descriptor field in the file entry

RBP	Length	Content
0	8	Allocation descriptor:extent A (AV extent)
8	8	Allocation descriptor:extent S (Defective extent)
16	8	Allocation descriptor:extent B (AV extent)
24	8	Allocation descriptor:extent C (AV extent)
32	8	Allocation descriptor:extent E (Padding extent)

Length of allocation descriptor = L_AD, Length of extended attribute = L_EA, a = L_EA+ 176

FIG. 4A

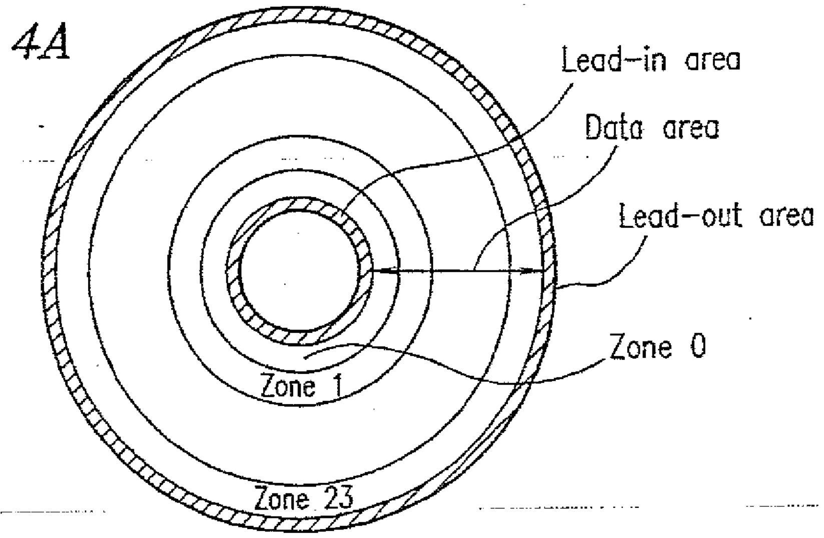


FIG. 4B

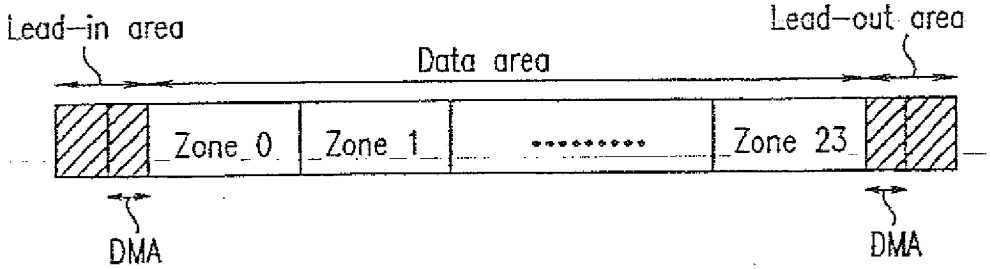


FIG. 4C

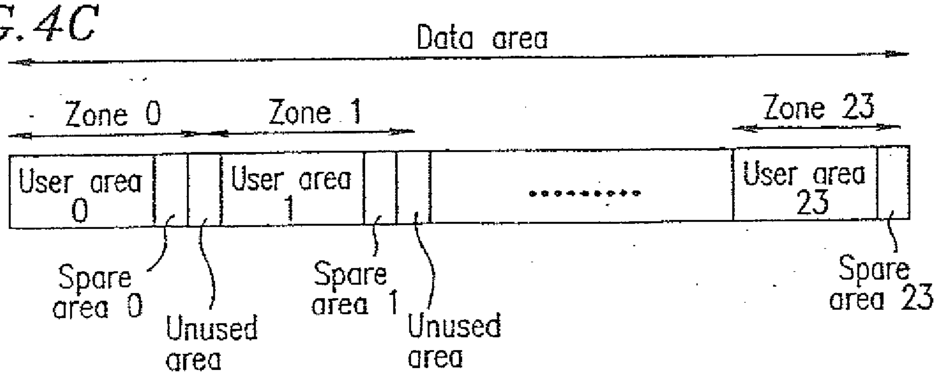


FIG. 4D

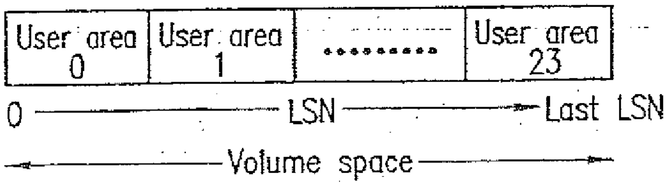


FIG. 5

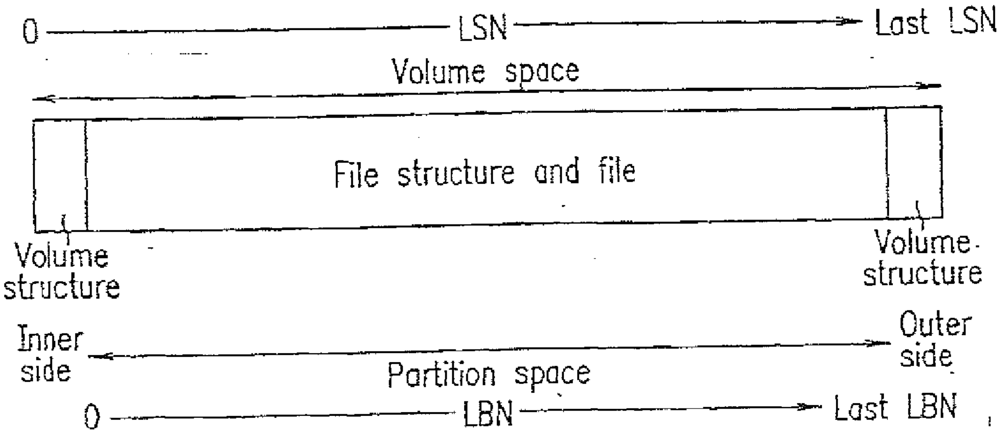

0
LSN
Last LSN
Volume space
File structure and file
Volume structure
Volume structure
Inner side
Outer side
Partition space
0
LBN
Last LBN

FIG. 6

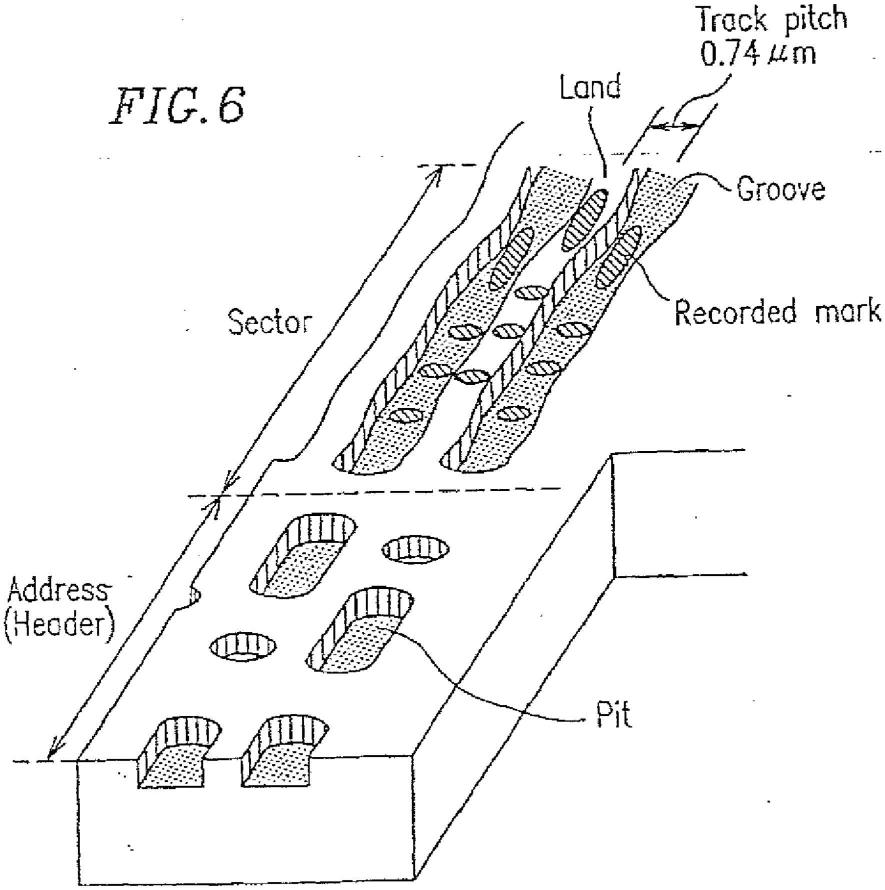

Track pitch 0.74 µm
Land
Groove
Sector
Recorded mark
Address (Header)
Pit

FIG. 7

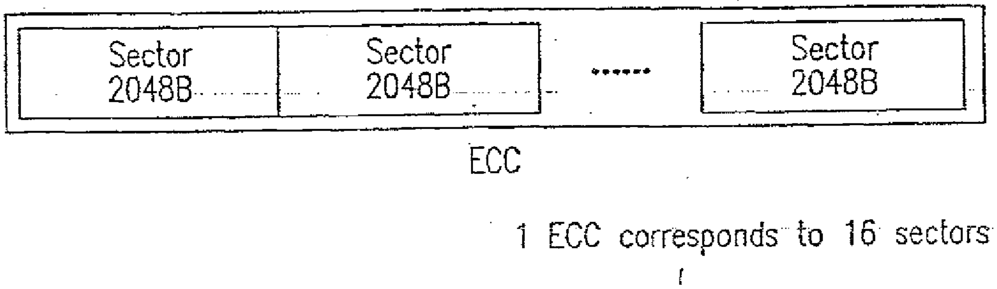

Sector
2048B
Sector
2048B
......
Sector
2048B
ECC
1 ECC corresponds to 16 sectors

FIG. 8

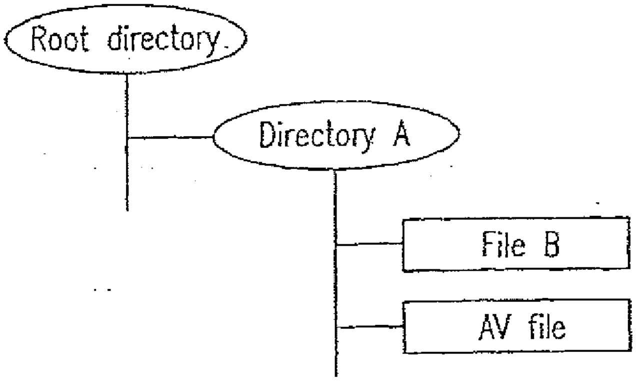
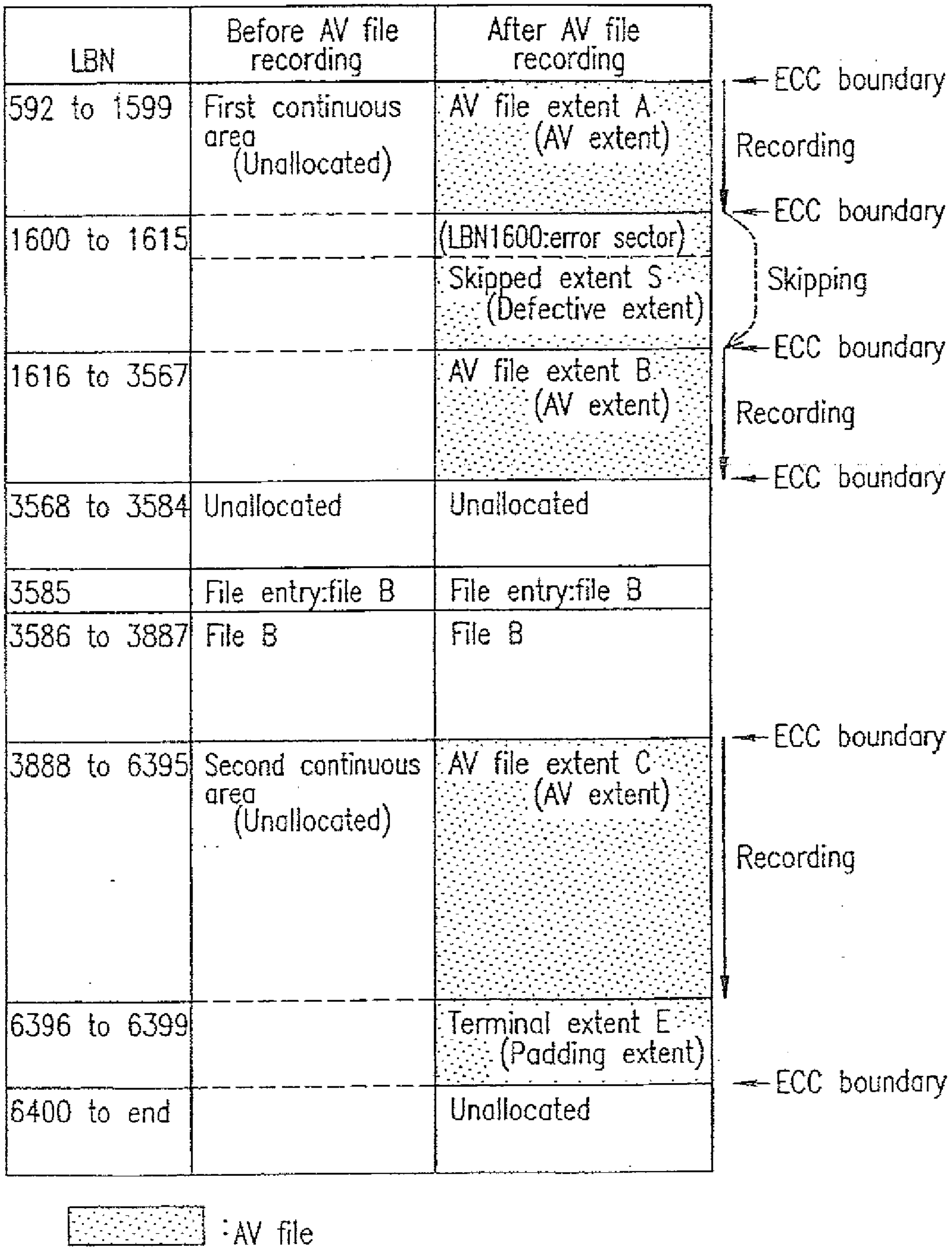

Root directory
Directory A
File B
AV file

FIG. 9



LBN	Before AV file recording	After AV file recording
592 to 1599	First continuous area (Unallocated)	AV file extent A (AV extent)
1600 to 1615		(LBN1600:error sector) Skipped extent S (Defective extent)
1616 to 3567		AV file extent B (AV extent)
3568 to 3584	Unallocated	Unallocated
3585	File entry:file B	File entry:file B
3586 to 3887	File B	File B
3888 to 6395	Second continuous area (Unallocated)	AV file extent C (AV extent)
6396 to 6399		Terminal extent E (Padding extent)
6400 to end		Unallocated

▨ :AV file

FIG. 10

Allocation descriptor

RBP	Length	Field name	Content
0	4	Extent length	Unit32
4	4	Extent location	Unit32

FIG. 11A

Interpretation of upper 2 bits of extent length of allocation descriptor (Non-AV file)

Value	Interpretation
0	Allocated and recorded extent
1	Allocated and unrecorded extent
2	Reserved
3	The extent is the following extent of allocation descriptors

FIG. 11B

Interpretation of upper 2 bits of extent length of allocation descriptor (AV file)

Value	Interpretation
0	Allocated and recorded extent (AV extent)
1	Allocated and unrecorded extent (Padding extent)
2	Skipped unrecorded extent (Defective extent)
3	The extent is the following extent of allocation descriptors

FIG. 12

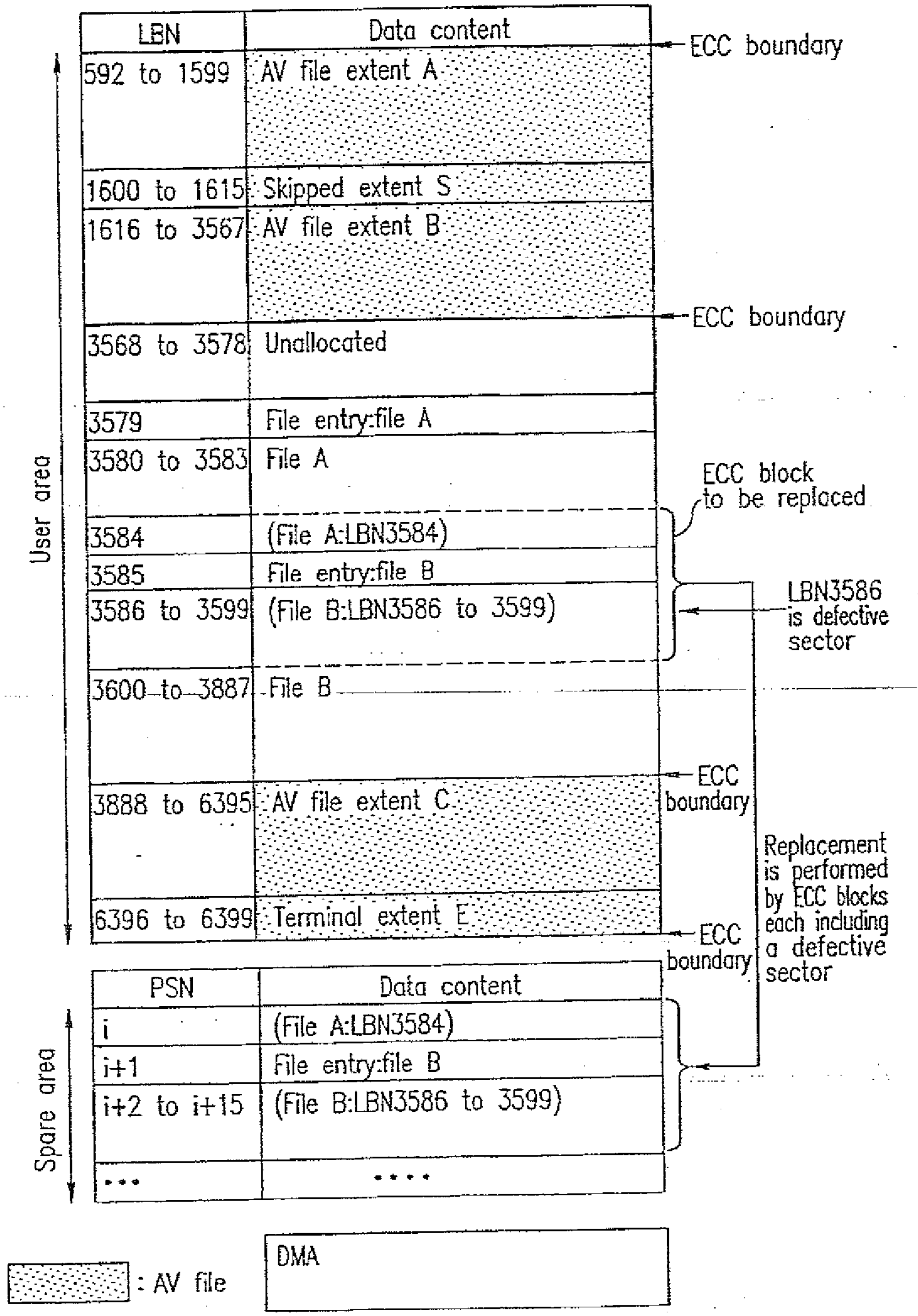

LBN
Data content
ECC boundary
592 to 1599
AV file extent A
1600 to 1615
Skipped extent S
1616 to 3567
AV file extent B
ECC boundary
3568 to 3578
Unallocated
3579
File entry:file A
3580 to 3583
File A
ECC block to be replaced
3584
(File A:LBN3584)
3585
File entry:file B
3586 to 3599
(File B:LBN3586 to 3599)
LBN3586 is defective sector
3600 to 3887
File B
ECC boundary
3888 to 6395
AV file extent C
Replacement is performed by ECC blocks each including a defective sector
6396 to 6399
Terminal extent E
ECC boundary
User area
PSN
Data content
i
(File A:LBN3584)
i+1
File entry:file B
i+2 to i+15
(File B:LBN3586 to 3599)
•••
••••
Spare area
: AV file
DMA

FIG. 13

LBN	Before AV file recording	Recording AV reserved file	After AV file recording
590	Unallocated	File entry:AV reserved file	Unallocated
591		Unallocated	File entry:AV file
592 to 1599	First continuous area (Unallocated)	Extent K for AV reserved file (Allocated)	▨ AV file extent A (AV extent)
1600 to 1615			(LBN1600:error sector) ▨ Skipped extent S (Defective extent)
1616 to 3567			▨ AV file extent B (AV extent)
3568 to 3584	Unallocated	Unallocated	Unallocated
3585	File entry:file B	File entry:file B	File entry:file B
3586 to 3887	File B	File B	File B
3888 to 6395	Second continuous area (Unallocated)	Extent L for AV reserved file (Allocated)	▨ AV file extent C (AV extent)
6396 to 6399			▨ Terminal extent E (Padding extent)
6400 to end			Unallocated

▨ : AV file

FIG. 14

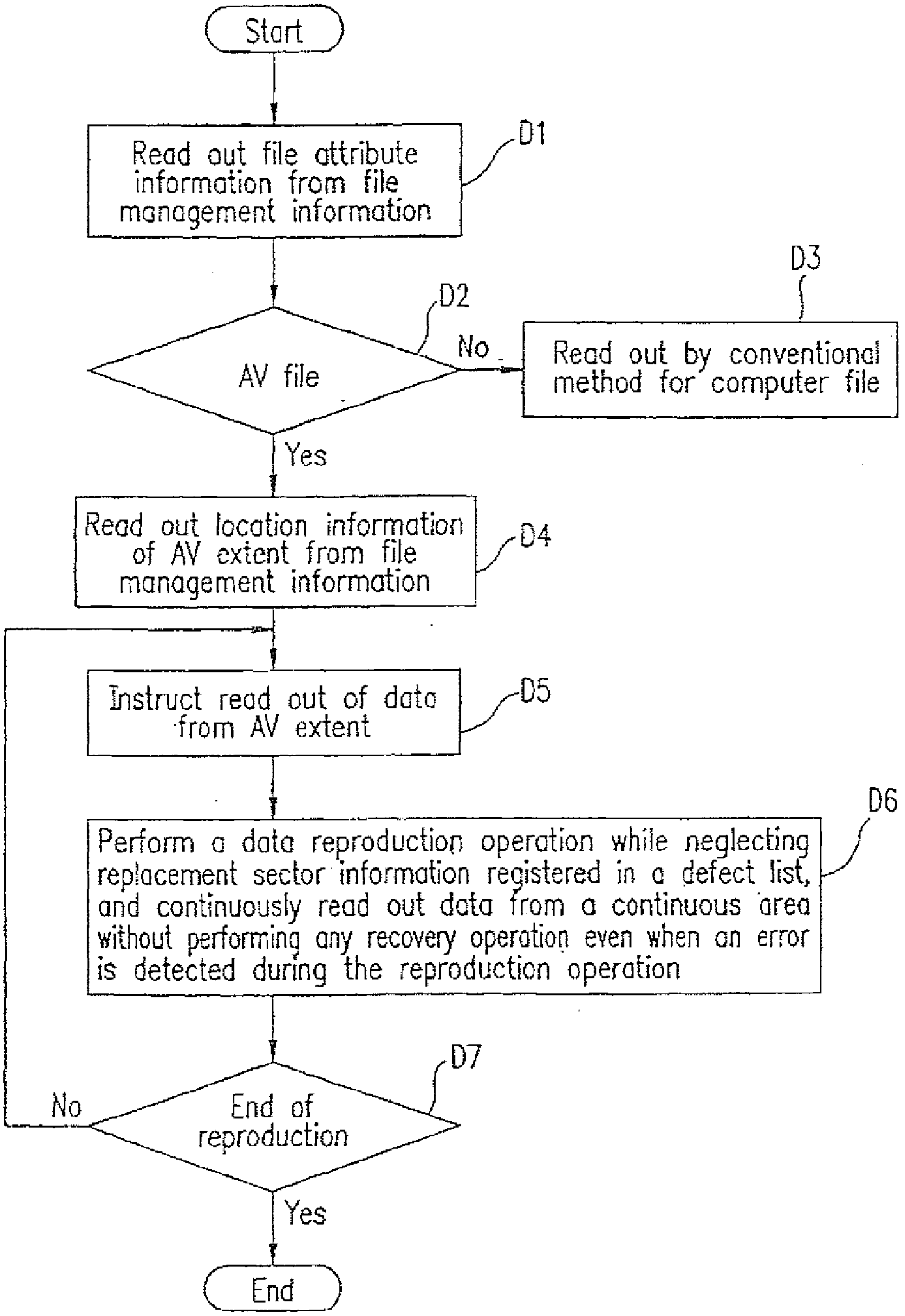
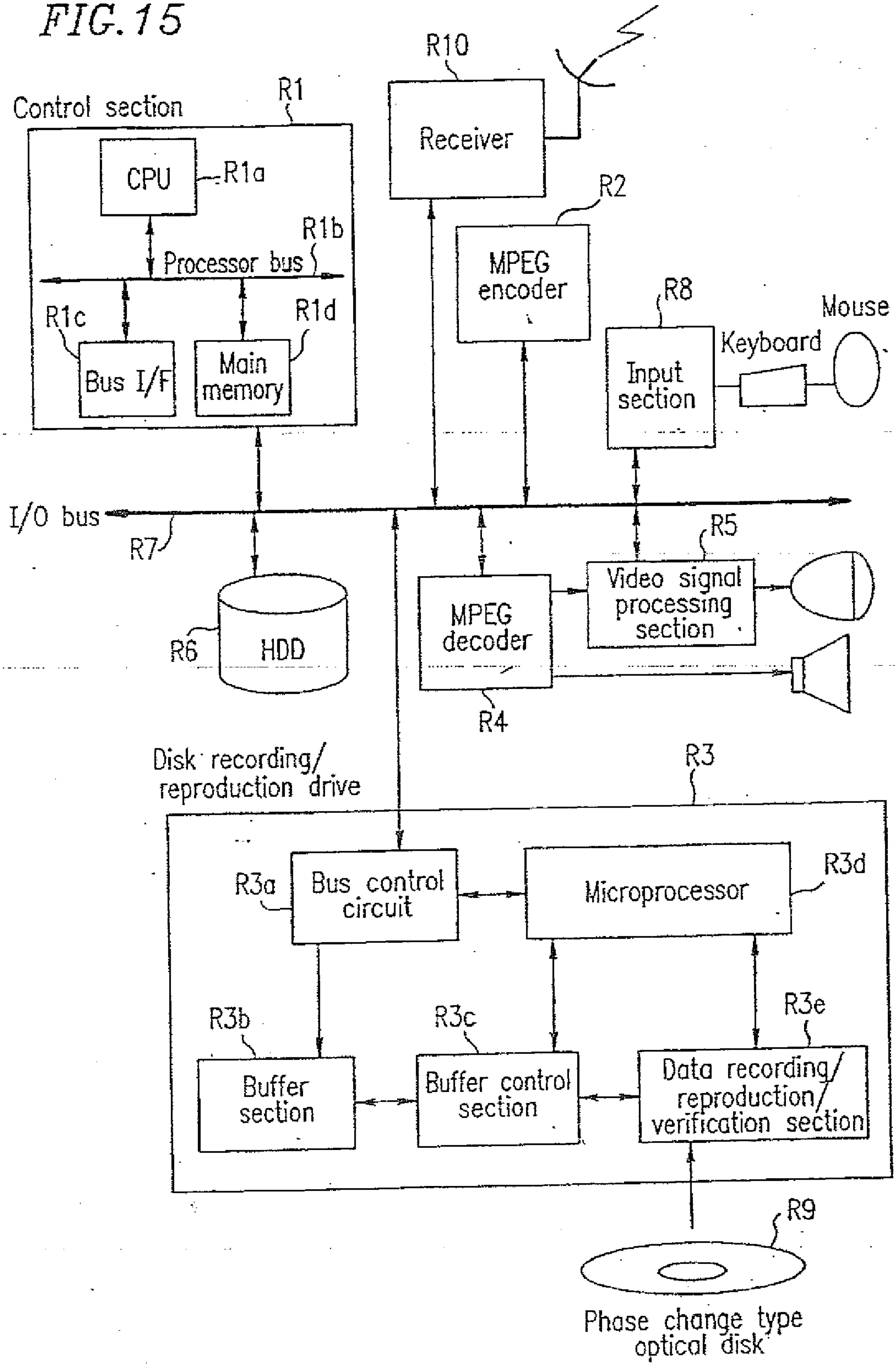

Start
Read out file attribute information from file management information
D1
AV file
D2
No
Read out by conventional method for computer file
D3
Yes
Read out location information of AV extent from file management information
D4
Instruct read out of data from AV extent
D5
Perform a data reproduction operation while neglecting replacement sector information registered in a defect list, and continuously read out data from a continuous area without performing any recovery operation even when an error is detected during the reproduction operation
D6
End of reproduction
D7
No
Yes
End

FIG.15



R10
Receiver
Control section
R1
CPU
R1a
R1b
Processor bus
R1c
R1d
Bus I/F
Main memory
R2
MPEG encoder
R8
Mouse
Keyboard
Input section
I/O bus
R7
R5
Video signal processing section
MPEG decoder
R6
HDD
R4
Disk recording/ reproduction drive
R3
R3a
Bus control circuit
Microprocessor
R3d
R3b
R3c
R3e
Buffer section
Buffer control section
Data recording/ reproduction/ verification section
R9
Phase change type optical disk

FIG. 16

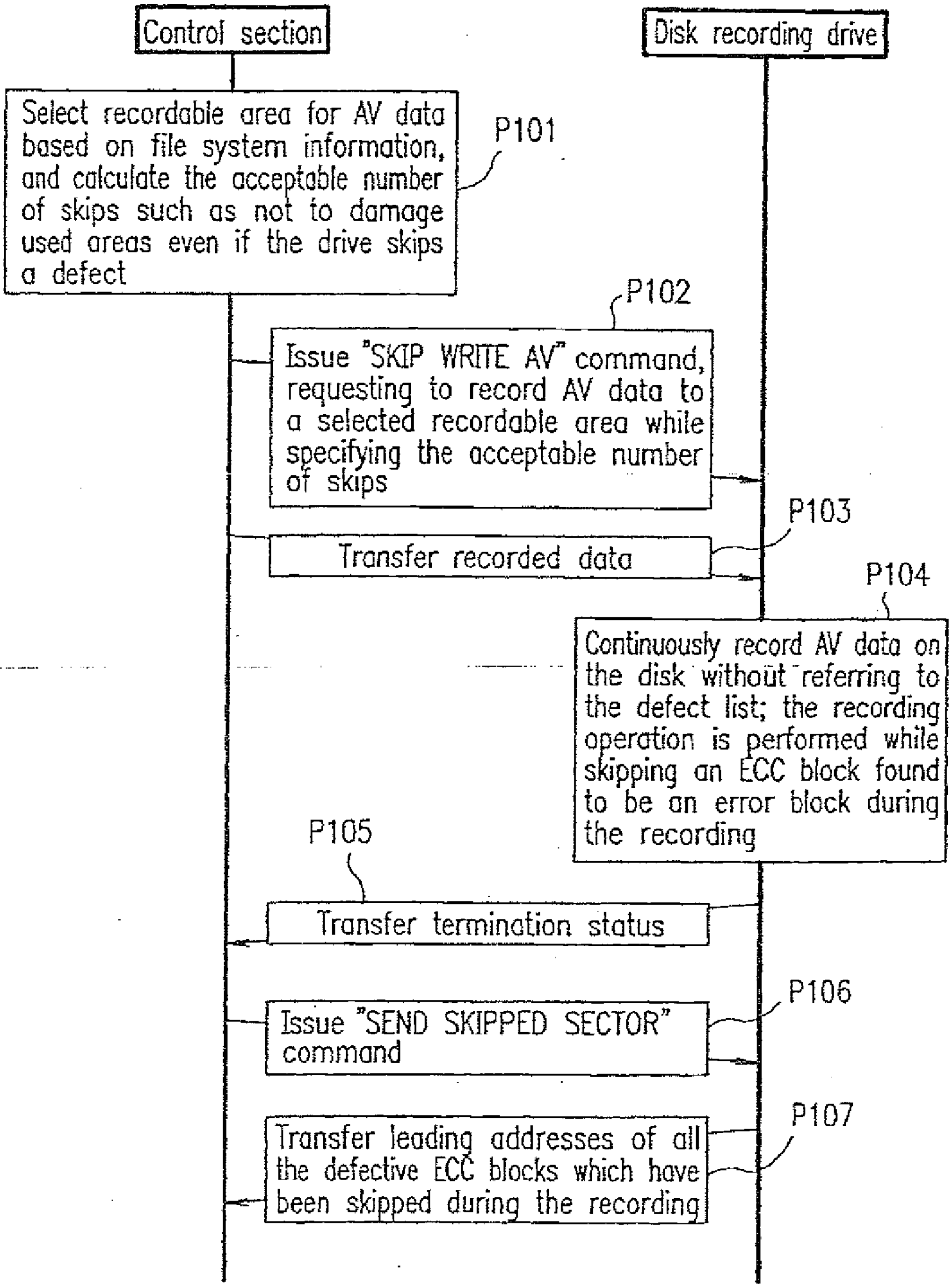

Control section
Disk recording drive
Select recordable area for AV data based on file system information, and calculate the acceptable number of skips such as not to damage used areas even if the drive skips a defect
P101
P102
Issue "SKIP WRITE AV" command, requesting to record AV data to a selected recordable area while specifying the acceptable number of skips
P103
Transfer recorded data
P104
Continuously record AV data on the disk without referring to the defect list; the recording operation is performed while skipping an ECC block found to be an error block during the recording
P105
Transfer termination status
P106
Issue "SEND SKIPPED SECTOR" command
P107
Transfer leading addresses of all the defective ECC blocks which have been skipped during the recording

FIG. 17

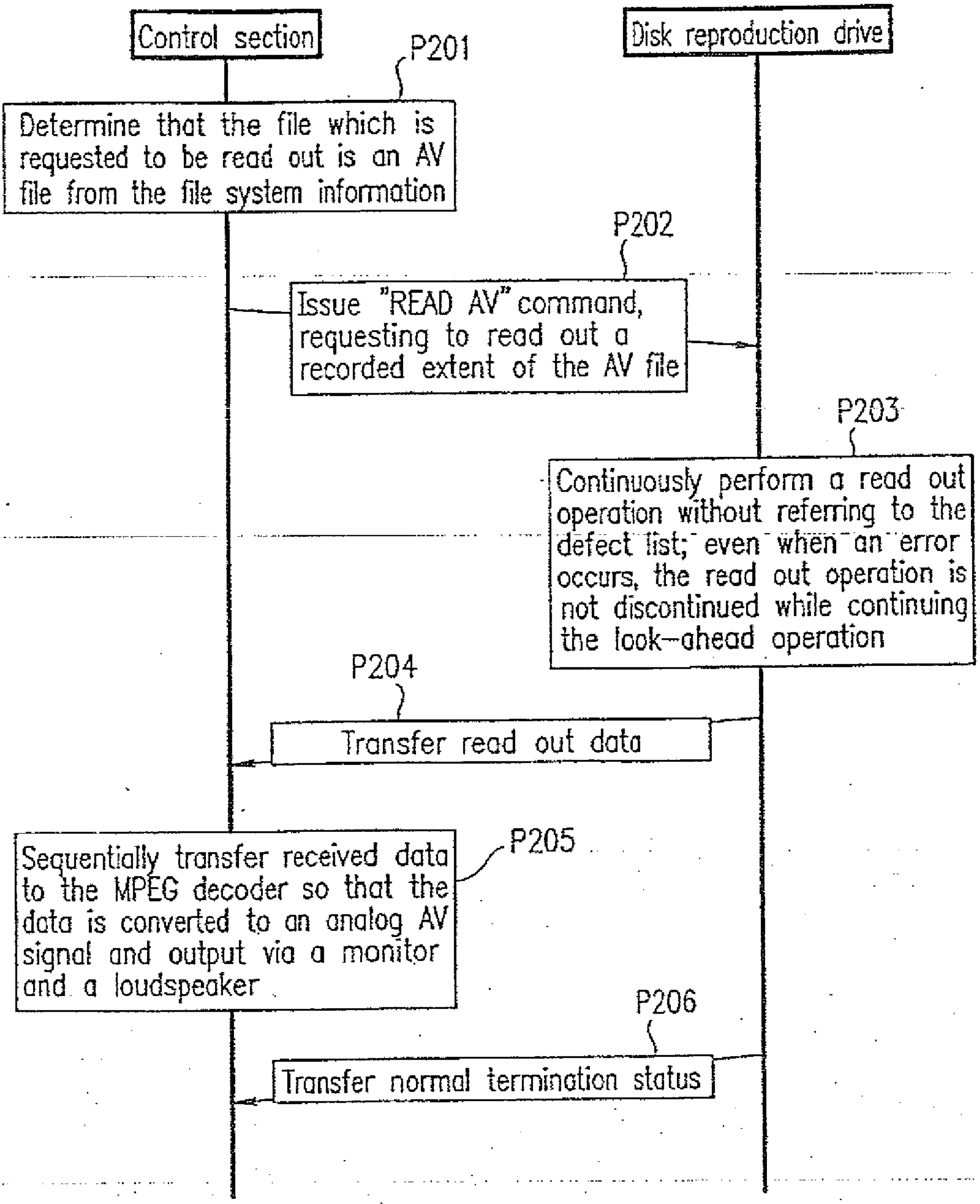

Control section
Disk reproduction drive
P201
Determine that the file which is requested to be read out is an AV file from the file system information
P202
Issue "READ AV" command, requesting to read out a recorded extent of the AV file
P203
Continuously perform a read out operation without referring to the defect list; even when an error occurs, the read out operation is not discontinued while continuing the look-ahead operation
P204
Transfer read out data
P205
Sequentially transfer received data to the MPEG decoder so that the data is converted to an analog AV signal and output via a monitor and a loudspeaker
P206
Transfer normal termination status

FIG. 18

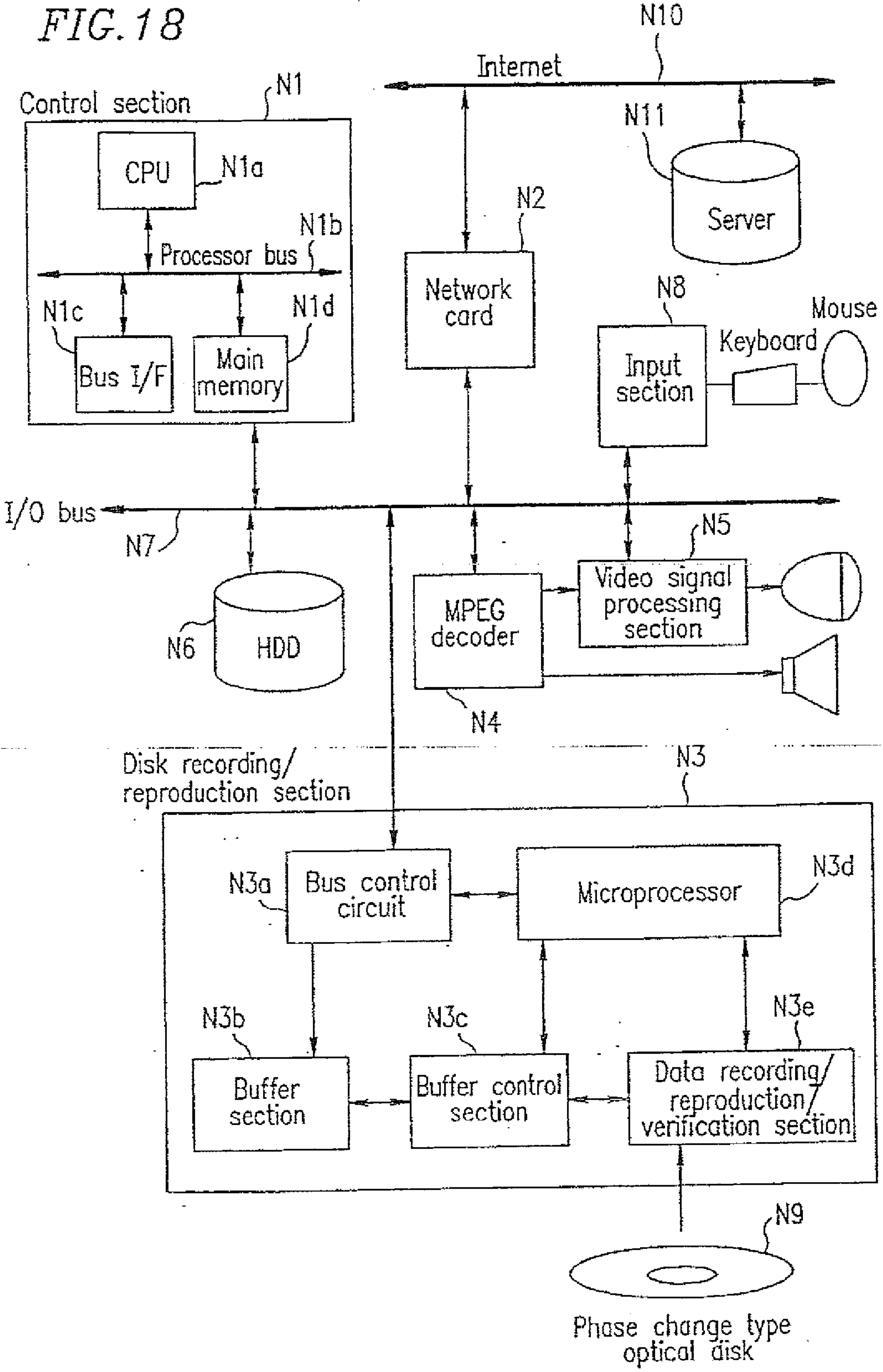

N10
Internet
Control section
N1
CPU
N1a
N11
Server
N2
N1b
Processor bus
Network card
N8
Mouse
N1c
N1d
Keyboard
Bus I/F
Main memory
Input section
I/O bus
N7
N5
Video signal processing section
N6
HDD
MPEG decoder
N4
Disk recording/ reproduction section
N3
N3a
Bus control circuit
Microprocessor
N3d
N3b
N3c
N3e
Buffer section
Buffer control section
Data recording/ reproduction/ verification section
N9
Phase change type optical disk

FIG. 19

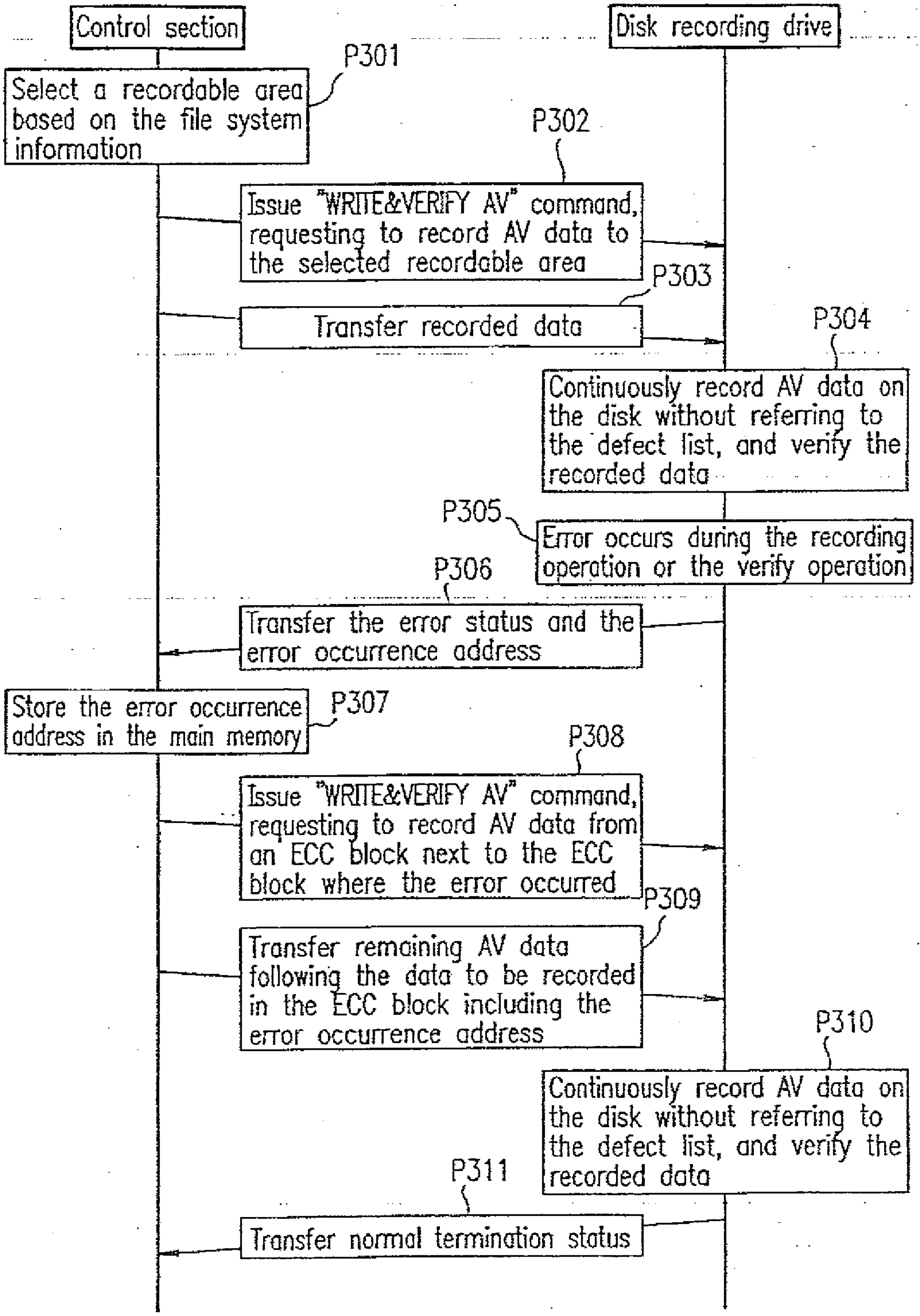

Control section
Disk recording drive
P301
Select a recordable area based on the file system information
P302
Issue "WRITE&VERIFY AV" command, requesting to record AV data to the selected recordable area
P303
Transfer recorded data
P304
Continuously record AV data on the disk without referring to the defect list, and verify the recorded data
P305
Error occurs during the recording operation or the verify operation
P306
Transfer the error status and the error occurrence address
P307
Store the error occurrence address in the main memory
P308
Issue "WRITE&VERIFY AV" command, requesting to record AV data from an ECC block next to the ECC block where the error occurred
P309
Transfer remaining AV data following the data to be recorded in the ECC block including the error occurrence address
P310
Continuously record AV data on the disk without referring to the defect list, and verify the recorded data
P311
Transfer normal termination status

FIG. 20A

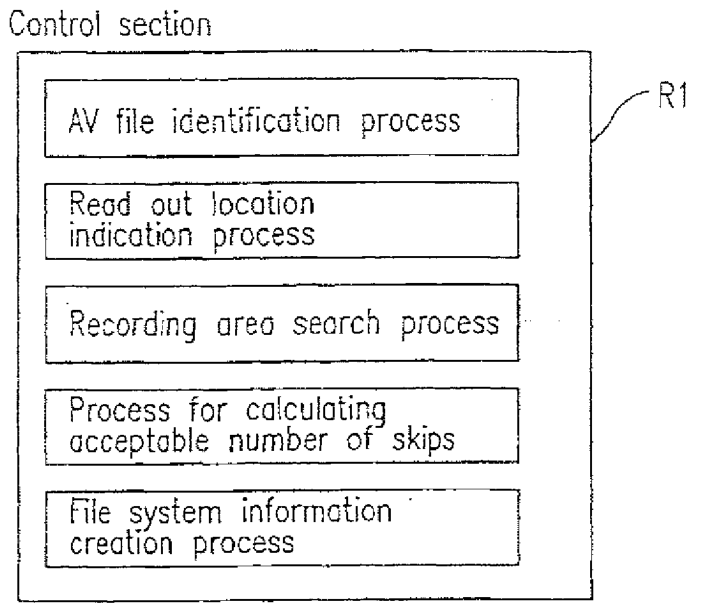

Control section
AV file identification process
Read out location indication process
Recording area search process
Process for calculating acceptable number of skips
File system information creation process
R1

FIG. 20B

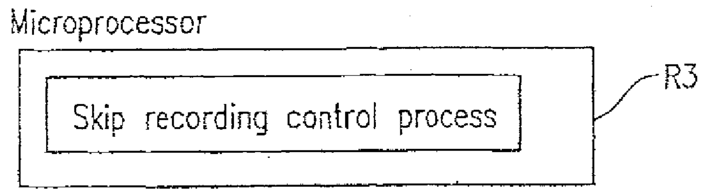


FIG.21

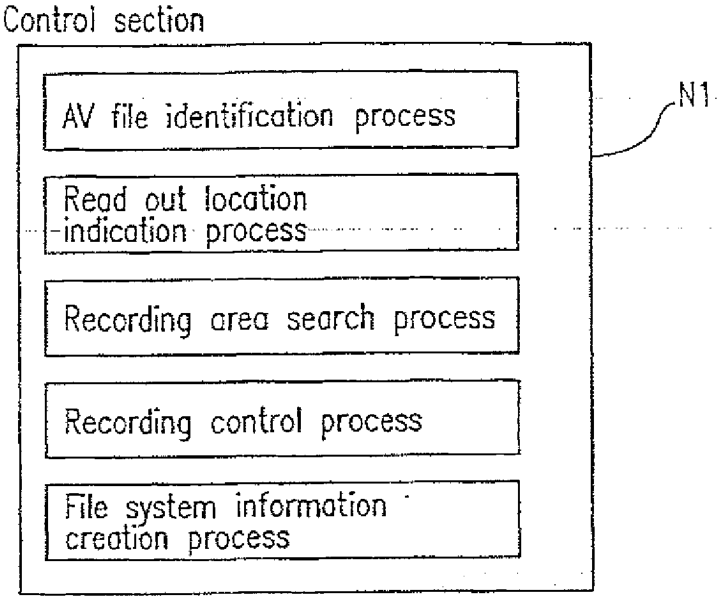

Control section
AV file identification process
Read out location indication process
Recording area search process
Recording control process
File system information creation process
N1

FIG.22

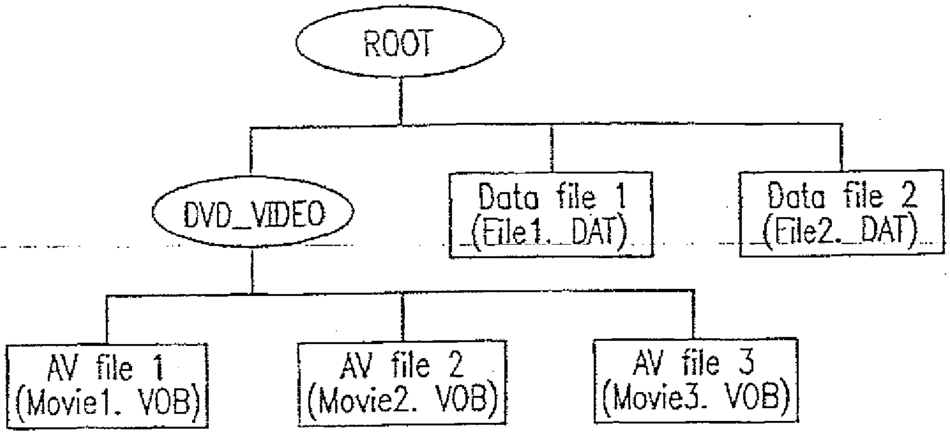
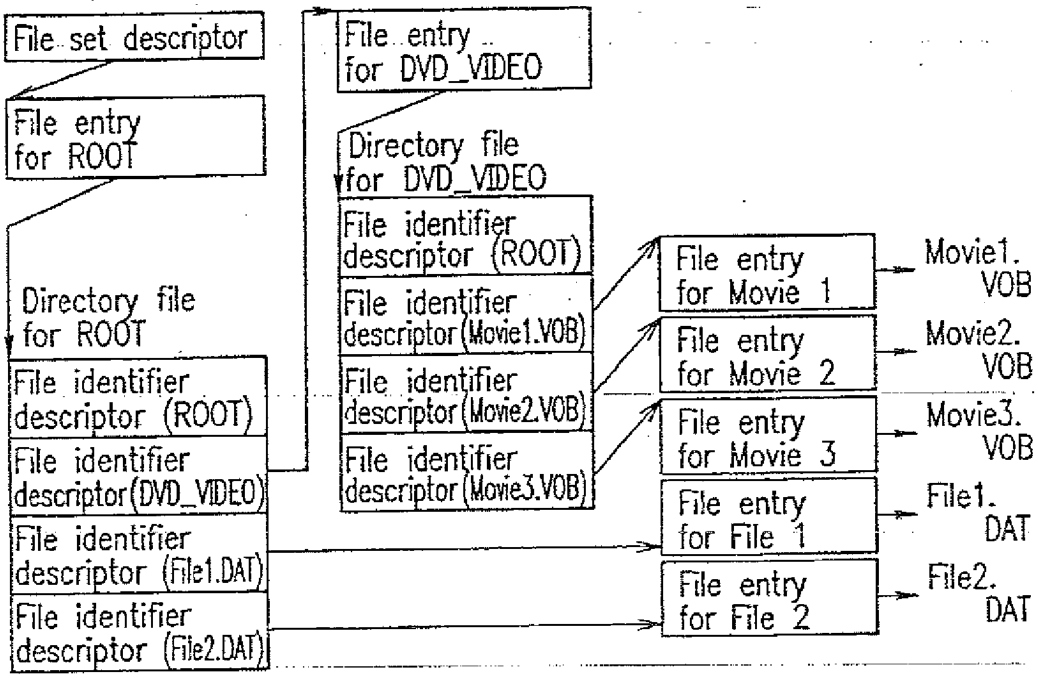

ROOT
DVD_VIDEO
Data file 1
(File1._DAT)
Data file 2
(File2._DAT)
AV file 1
(Movie1. VOB)
AV file 2
(Movie2. VOB)
AV file 3
(Movie3. VOB)

FIG. 23


File set descriptor
File entry for ROOT
Directory file for ROOT
File identifier descriptor (ROOT)
File identifier descriptor (DVD_VIDEO)
File identifier descriptor (File1.DAT)
File identifier descriptor (File2.DAT)
File entry for DVD_VIDEO
Directory file for DVD_VIDEO
File identifier descriptor (ROOT)
File identifier descriptor (Movie1.VOB)
File identifier descriptor (Movie2.VOB)
File identifier descriptor (Movie3.VOB)
File entry for Movie 1
File entry for Movie 2
File entry for Movie 3
File entry for File 1
File entry for File 2
Movie1. VOB
Movie2. VOB
Movie3. VOB
File1. DAT
File2. DAT

File identifier descriptor for directory

Management information
Identification information (Directory)
Directory name length
File entry address
Information for extension
Directory name

File identifier descriptor for file

Management information
Identification information (File)
Directory name length
File entry address
Information for extension
File name

FIG. 24

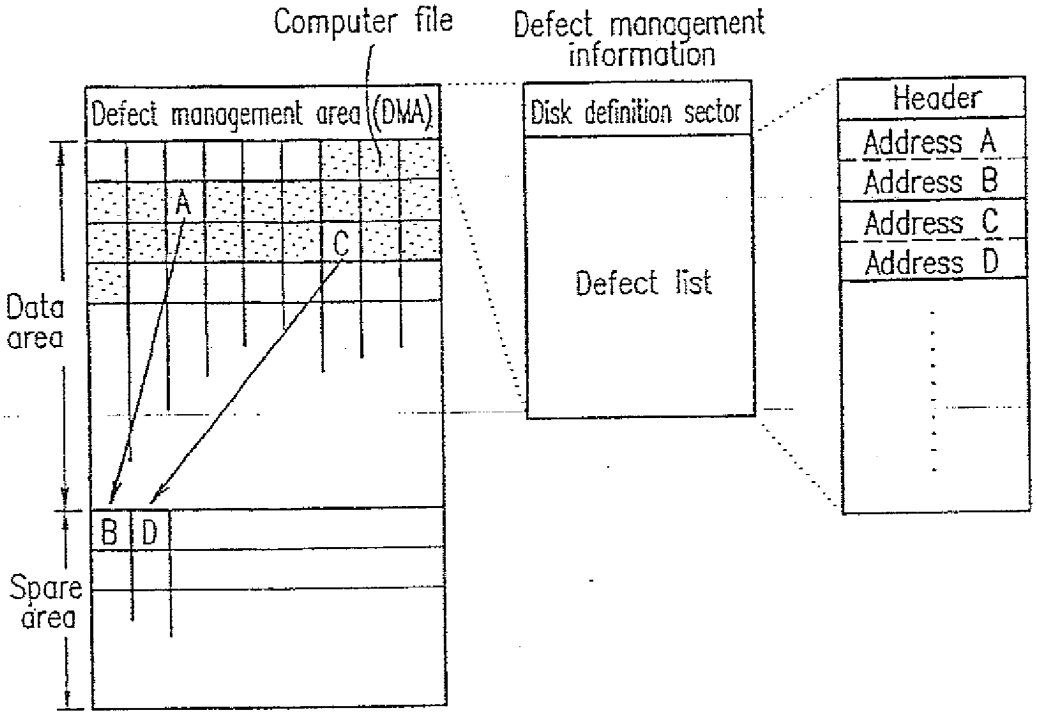

Computer file
Defect management information
Defect management area (DMA)
Disk definition sector
Header
Address A
Address B
Address C
Address D
A
C
Defect list
Data area
B
D
Spare area

FIG. 25

ICB tag of file entry

RBP	Length	Field name	Content
0	4	Number of previously recorded direct entries	Unit32
4	2	Strategy type	Unit16
6	2	Strategy parameter	Unit16
8	2	Maximum number of entries	Unit16
10	1	Reserved	00h byte
11	1	File type	Unit8
12	6	Parent ICB location	1b_addr
18	2	Flag	Unit16

FIG. 26

Flag fields of ICB tag

Bit	Description	Remarks
0--2	Type of allocation descriptor	
3	Directory sort	
4	Non-relocatable	
5	Archive	
6	Setuid	
7	Setgid	
8	Sticky	
9	Contiguous	AV attribute bit indicating AV file
10	System	
11	Transformed	
12	Multi-version	
13–15	Reserved	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP97/03473

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl^6 G11B20/12, 20/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int. Cl^6 G11B20/12, 20/18

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1926 - 1997
Kokai Jitsuyo Shinan Koho	1971 - 1997
Toroku Jitsuyo Shinan Koho	1994 - 1997

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP, 4-28061, A (Matsushita Electric Industrial Co., Ltd.), January 30, 1992 (30. 01. 92) (Family: none) Page 4, lower right column, lines 6 to 10; page 7, lower right column, line 16 to page 10, lower left column, line 15	1-3, 8, 9, 10, 12, 17, 18, 21-23
Y	Page 10, lower left column, line 16 to page 11, upper right column, line 1	19, 20
A		4-7, 11, 13-16, 24-27
Y	JP, 5-342759, A (Matsushita Electric Industrial Co., Ltd.), December 24, 1993 (24. 12. 93), Column 1, line 31 to column 2, line 9; column 4 lines 18 to 40 (Family: none)	19, 20

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"E" earlier document but published on or after the international filing date
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"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search December 15, 1997 (15. 12. 97)	Date of mailing of the international search report December 24, 1997 (24. 12. 97)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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